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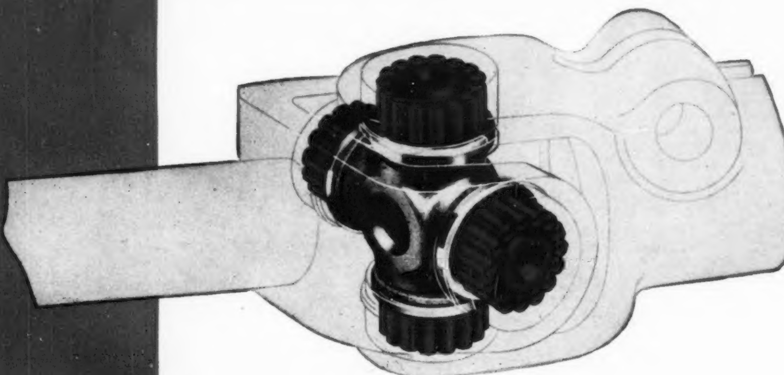

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AGRICULTURAL ENGINEERING

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CONTENTS FOR JUNE, 1951

Vol. 32, No. 6

AGRICULTURAL ENGINEERING is indexed regularly by Engineering Index, Inc.

INDEX TO ADVERTISERS

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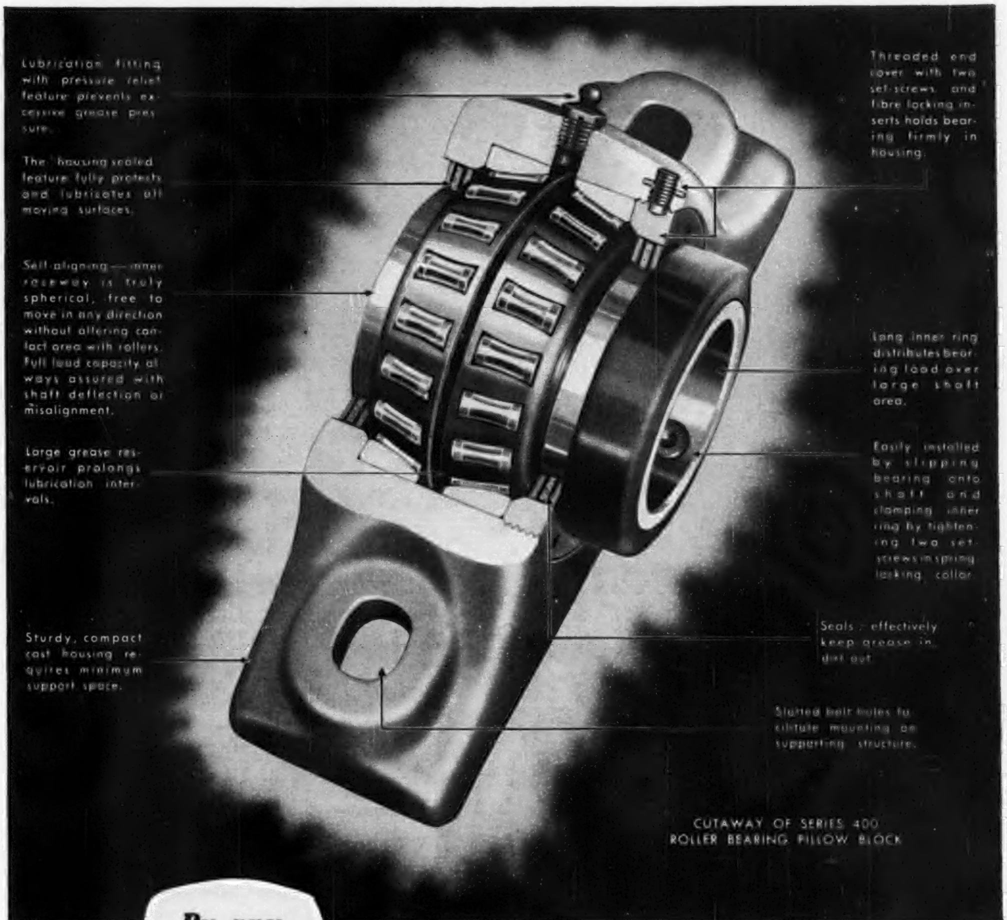

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● **Merle Noble (left) and James Howschultz (seated)** explain details of their weed and insect sprayer to Texaco Man Gene Carlson, as Rudolph Howschultz looks on. The 9-h.p. engine gets Havoline Motor Oil, which insures not only the finest lubrication but also protection against rust during the winter when the engine is idle.

MR. Merle Noble and Mr. James Howschultz, who farm 900 acres near Blencoe, Iowa, built the novel sprayer shown above out of parts of old cars and machinery found around the farm. The steering gear was made out of a Model T rear end. The propelling mechanism works through an old Dodge transmission and another old Model T rear end. Two old oil drums welded together make the 97-gallon tank. The sprayer arms are of ordinary pipe and can be raised or lowered to suit the height of the crop. The motor, which operates both the sprayer pump and provides traction, is a 9-h.p. engine.

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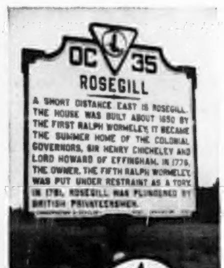
Joe Acosta a few years ago was farming 30 acres, now farms 1,500. He is shown using his field telephone in one of his trucks. Texaco Man Jackie Field is on hand with Havoline, the motor oil that more than meets standards established for Premium and Heavy Duty motor oils.



Friendly Texaco Service at Rosegill Plantation, near Urbanna, Virginia. Fire-Chief Gasoline, with superior *"Fire-Power"* for low-cost operation, is used in cars and trucks at famous Rosegill Farm. Texaco Man W. J. Revere (left) pays a friendly visit to Manager Sam Bray, who has a fine herd of 170 purebred Guernseys.

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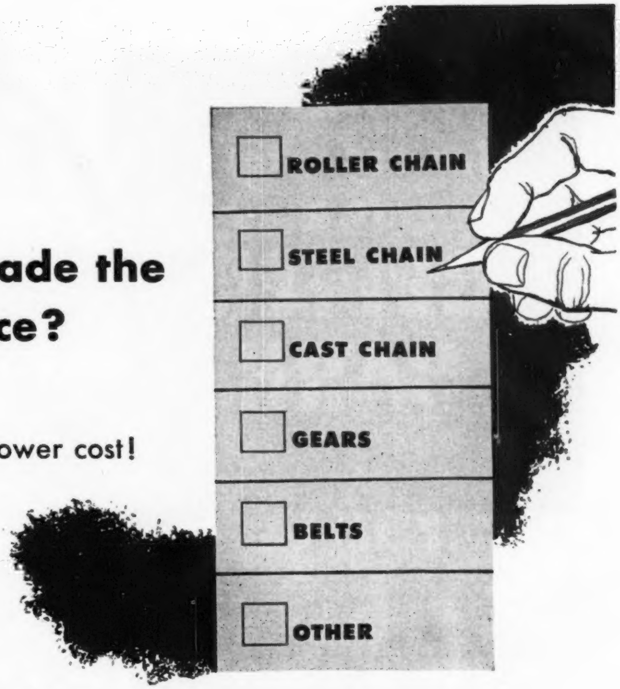

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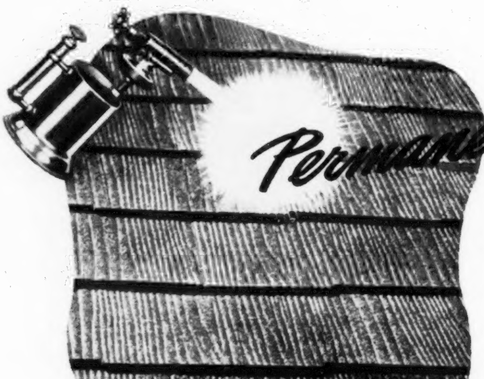

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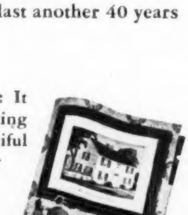

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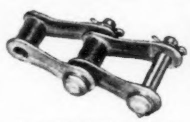

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CHAINS AND SPROCKETS

EDITORIAL

A Welcome to Graduates

TO THIS year's graduates in agricultural engineering, our congratulations and a hearty welcome into the fellowship of working agricultural engineers.

There's a big job to be done, and you can help do it.

It may take you some time to find the place and manner in which you can work most effectively. You are not a standardized product, and opportunities to apply and further develop your engineering abilities are likewise not standardized.

Considering the relative scarcity and high demand for agricultural engineers, some employers may seem overly cautious and conservative in giving you the once-over in relation to specific openings. It is to your interest. Unsuccessful tryouts are costly to you as well as to an employer. Some of the best employers to work for are those who would rather hire one less man than one wrong man.

If you are among those called for a period of duty in the armed services, you will not be the only agricultural engineer thus separated from his chosen field of work. Some sixty or more are already on active duty. Others will go as and when called. There is a lot of important engineering work to be done, under challenging conditions, in several branches of the armed forces.

Wherever you go, you should find support and encouragement for sound engineering performance; opportunity to demonstrate your capacity to work effectively with materials, forces, people, and problems. That is your real welcome into agricultural engineering.

Balanced Extension

AGRICULTURAL extension by subject-matter specialists has resulted in much piecemeal instruction, so far as the individual farmer has been concerned. It still does in some areas.

There has been a lot of good in it. It has been particularly helpful to the progressive farmer capable of picking up scraps of information where he found them, evaluating them, and applying some of them to his own farming practices. He has had the ability and initiative to go to the soils specialist for information on how to handle his soil; to the crop specialist for information on what to grow and how to grow it; to the livestock specialist for the latest on breeding and feeding practices; to the agricultural engineer for help in implementing sound agricultural practices, and to the economist for the know-how to figure his costs. He has been enough of a business man to combine these practices into a profitable operation and more satisfying ways of living.

In effect, the subject-matter specialists have said to farmers, "Here are your bootstraps, lift yourselves." Some farmers have been able to carry on from there on their own initiative, but many have not.

Good subject-matter extension work produced minimum results among the farmers who needed it most, simply because it did not go quite far enough.

It produced a generation of farmers who knew considerably more than they practiced. They received little help from subject-matter specialists or anyone else in identifying and overcoming the bottlenecks in their individual operations. They received little help in the over-all planning necessary to combine a variety of subject-matter recommendations into an improved system of operation with assurance that every factor important to success had been considered.

With a few outstanding exceptions, such as the acceptance of hybrid corn, the relayed adoption of practices recommended by extension specialists, through farmers imitating their more successful neighbors, has been slow.

We would not give the impression that extension men have been overly self-satisfied. They have recognized and faced daily the difficult problem of dividing their time between the most responsive farmers who need help the least, where extension work will show the earliest and largest concrete results; and the less responsive farmers who need help the most, who may or may not be beyond helping, where there is the greatest room for improvement, but among whom effective work is most difficult and visible results most discouraging.

There are undoubtedly some points in favor of concentrating extension effort where it can show the best results. However, it amounts to helping the fittest farmers to survive and become still better, while neglecting those in greatest need of help to help themselves. It would be a hard doctrine. Its support from public funds derived through the processes of representative self-government would be difficult to justify and maintain. Its espousal by any public-service extension leader has escaped our notice. As an alternative, some extension leaders have taken a big step toward making extension work more effective among farmers who need more help than can be provided by the best efforts of individual subject-matter specialists.

Without waiting to be shown, the agricultural extension service of the "show-me" state, has undertaken to do the showing for those Missouri farmers who might benefit from an additional boost in introducing new knowledge into their practices. Instead of limiting its function to being a superior authority on the agricultural sciences, it is helping farmers to organize their farms and operations for effective, profitable production and good living. Agricultural Extension Director J. W. Burch of Missouri told agricultural engineers about it at the meeting of the Mid-Central Section of the ASAE at Columbia in March.

Missouri is helping its farmers into balanced and profitable farming by balanced extension work. It isn't new. The idea and method have been under development there for 15 years. Substantially the same idea and methods are being used successfully in other states. The point of emphasizing it now is that it has proven effective enough to warrant well-nigh universal adoption.

And it is extension work in which agricultural engineering can show its real merit in implementing sound agricultural practices.

Freedom for Engineers

IN THE memoirs of Herbert Hoover we find a neat little reminder that to enjoy the advantages of engineering and engineered production, a people must give engineers freedom to work effectively.

Referring to a mining and smelting operation in Russia, Hoover recalls that "The Kyshtim business prospered until 1917. . . . With the revolution in 1917 the communists took over. Then began the hideous tragedy of enthroned ignorance. First, the metallic mixtures in one of the large furnaces were unbalanced and the furnace 'froze'. The chemical cycles failed likewise. In a week the works were shut down."

The communists wanted that operation and production to continue. They tried to keep it going without the aid of capitalist foreign engineers. But the physical facts could not be intimidated. Natural law is no respector of edicts, isms, or armed force. The job just could not be bulled through. It required more knowledge and skill than they realized.

Since then the communists have learned that lesson in part. They have acquired a measure of respect for the facts of physical nature, if not for the realities of human nature and human relationships.

Some other people and governments still have that lesson to learn or relearn. Some need to guard against forgetting it, and to apply it more fully. The United States may be one of the latter.

Populations and governments cannot all become engineers, but they can be shown that it will be to their own interest to stand back out of the way and let engineers direct engineering operations.

AGRICULTURAL ENGINEERING

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Grassland Agriculture — A Challenge to Engineers

By E. W. Hamilton
LIFE MEMBER A.S.A.E.

GRASSLAND agriculture has always been with us even though we have not always recognized it for what it really is. When the Pilgrim Fathers stepped from Plymouth Rock they found themselves in bluestem up to their armpits, and when the early colonists gave way to the urge to go West their wandering paths were surrounded by grass everywhere. On the hillside and through the valley, lowland and upland, dry draw and river bank, high up on the mountain sides and even in desert areas, they saw the grasses on every hand, and they instinctively knew that those grasses provided assurance of abundant food for both man and beast.

But, because man has only one stomach instead of the four of the ruminant, man's metabolism is not equal to the task of using the grasses direct, and consequently must depend upon the ruminant for conversion of the grasses and legumes into meat, milk and eggs — mankind's food triumvirate — even though Nebuchadnezzar in biblical days was obliged to eat the grass of the field as punishment for his disobedience.

When the American Society of Agricultural Engineers was organized approximately 43½ years ago, the term "grassland agriculture" had little or no engineering application, and it certainly did not attract any serious attention from the agricultural engineer, judging from the discussions at early Society meetings. It should be remembered that, at that time, the embryo of the farm mechanization egg had only just begun to stir within its shell. The birth of the Society and the birth of farm mechanization, as we think of it today, were almost simultaneous. Horse and mule power was the prime mover in our farming operations, and our grass fields were looked upon as the main sources of horse and mule roughage. Timothy and red top hay constituted the backbone of our tame grassland program aside from scattered areas of bluegrass pastures. The legumes were only just beginning to come into the picture.

It might be of interest in passing to note that most of the tame grasses as we know them today were not here when the early colonists arrived. Such grasses as timothy, red top, bluegrass, orchard grass, brome grass, Rhodes grass, Dallis grass, rye grass, the wheat and oat grasses, etc., which are common today, are all imports. The bluestems, the gramas, stipas, love grasses and other native prairie grasses were about all that greeted the early settlers. Even white clover had not yet made its appearance on American soil.

It is also interesting to note that, whereas we are apt to consider the northeast section of the United States as our main grassland area, as distinguished from the corn, cotton and wheat belts, when the early colonists came to America that same northeast section was largely a timber area with only a few scattered meadows, whereas the section between latitudes 20 and 54 degrees North and longitudes 80 and 100 degrees West were the grazing grounds of the herds of buffalo who knew where the rich nutritive grasses grew.

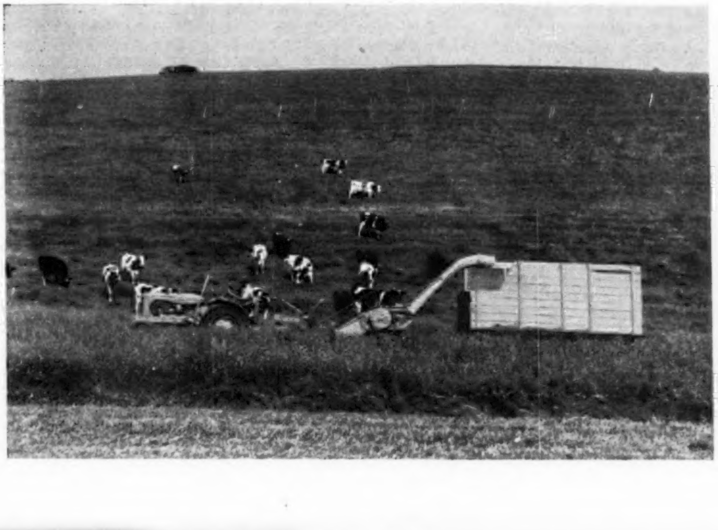
The American Society of Agricultural Engineers, not as a Society but through many of its early members and friends, had much to do with the passing of the horse and the mule. Those men had nothing against animal power on our farms, but their engineering thinking, as applied to agriculture, visioned the agricultural potentialities of the internal-combustion tractor as a means of farm power. They were much more interested in the gasoline engine than they were in horseshoes, trace chains, harness snaps and buckles.

The transition from animal to mechanical power on American farms affected many changes in various small businesses and organizations. The Horse Association of America, so ably piloted by Wayne Dinsmore for many years, has passed into oblivion, and the National Hay Association which depended largely upon the horse for its existence is gradually dwindling into a small group. Twenty years ago commercial hay accounted for more than 30 per cent of our tame hay crop, whereas today it handles scarcely 8 per cent. Commercial hay is mostly horse-consumed hay.

The Winnipeg Motor Contests were conducted from 1908 through 1913, making more farm tractor history than any other one thing at that time. Those contests were manned

This is an address delivered at the annual meeting of the Iowa-Illinois Section of the American Society of Agricultural Engineers at East Moline, Ill., May 5, 1951.

The author: E. W. HAMILTON has for many years been engaged in special research work related to advancement of grassland farming, for the Allis-Chalmers Mfg. Co., Tractor Division, Milwaukee, Wis.



The grassland, hay lands and range lands of the entire United States cover more than a billion acres, nearly 60 per cent of the total land area. Expansion and development of grassland areas to the fullest extent call for mechanized equipment, and of even newer and better types than we now have, to keep pace with improved methods of developing the grassland program. (Photo courtesy of Allis-Chalmers Mfg. Co.)

and judged almost entirely by agricultural engineers from the United States, among whom I might mention Dr. J. B. Davidson, L. W. Chase, P. S. Rose, H. W. Riley, H. M. Musselman, W. J. Gilmore, Dr. E. A. White, C. I. Gunness, and L. J. Smith.

Why should an agricultural engineer be interested in grassland agriculture? What has it to do with his profession?

Let us take the subject apart and see if it hasn't something which is very important to our agricultural economy — something in which every agricultural engineer is keenly interested and to which he has already made many valuable contributions, and, it is hoped, will continue to do so.

The grassland, hay lands and range lands of the entire United States cover more than a billion acres, nearly 60 per cent of the total land area. Originally, about 700 million acres were covered with grass. Nearly 250 million acres of that grassland have been plowed up and used for crops or for pasture in rotation with crops.

There are more than 1,500 different species of grasses in North America out of about 6,000 species known to the botanists of the world, but we have been very slow to evaluate the grasses and legumes in terms of cash crops which, I believe, is the main reason why the farmer has been slow to appreciate grassland agriculture as a vital part of his economy. He has concentrated most of his attention upon wheat, corn and cotton, giving only secondary consideration to the grasses.

This situation is beginning to be rapidly corrected, and grassland agriculture is spreading like a sheet of water finding its way over dry-dust areas, the areas of least resistance being the first to be covered, with all areas being touched as the tide rises.

Soil conservation, which is 28 years the junior of the professional activity of the American Society of Agricultural Engineers, as it did not become an organized national effort until 1935, when the Soil Conservation Service was set up by the U.S. Department of Agriculture under the Soil Conservation Act of the 74th Congress in that year, depends to a considerable extent upon grassland agriculture for the carrying out of a large number of its projects.

Certain soils demand periodic coverings of grasses and legumes, as, for example, black prairie soils and the Chernozone soils, for their permanent existence. This is often a matter apart from their fertility. Erosion by both wind and water is difficult to keep in check without the aid of a certain amount of grassland agriculture.

The wornout cotton fields of the South are gradually giving way to grass and legume fields with lespedeza, kudzu, lupine, croatalaria, and the burr clovers doing a grand job both with respect to conservation and fertility.

I can take you to several farms in the rougher and more hilly sections of Wisconsin where about the only crops which are raised are grasses and legumes. I have in mind one farm of 320 acres where 165 head of cattle are pastured and winter fed which has not been plowed for five years and where not one pound of grain is purchased. A dairy herd of 30 grade Holsteins is maintained on that farm and, despite the fact that every cow is in the 500-lb class, not one ounce of grain is fed — nothing but pasture, hay, and silage.

This farm is very well mechanized not only in the field, but its barns and barnyard are models of what mechanization can do in speeding up choretime and saving hand labor.

The dust bowl areas of the Southwest are turning to the grasses as rapidly as possible in their efforts to counteract the devastating effects which wind erosion has wrought at intervals since they were taken from the range and used for grain cropping.

Grassland agriculture has definitely come to mean a mechanized agriculture and this is one valid reason why the agricultural engineer must come into the picture. The problems which face the expansion and development of our grassland areas to the fullest extent are problems which call not only for the mechanized equipment we now have, but they will undoubtedly call for other new and better types with which to keep pace with changes in the methods of introducing an increased grassland program into our present crop and livestock economy.

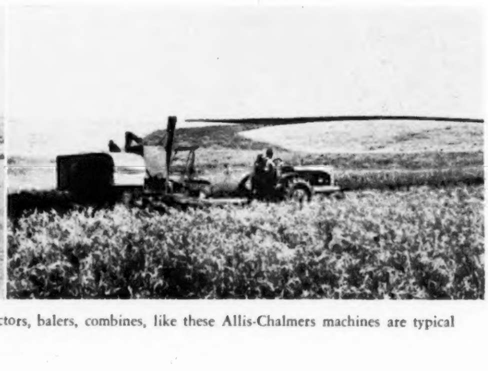
An interesting fact is that, while our horse and mule population is receding at a rate which will cause it to vanish within the next twenty years, our tame hay acreage is remaining at practically the same level from year to year — 65 to 70 million acres each year with an annual tonnage of around 100 million tons.

When we consider that our horse and mule population was approximately 25 million head in 1920 and that it is now less than 10 million head, it causes us to pause and wonder just what has happened to our tame grass tonnage. The answer lies pretty much in the fact that, during that time, our human population has increased from 105 to 150 million. Our food standards not only have been maintained but rather increased than decreased, and we now know that much of our grass crop is finding its way to our dinner tables in the shape of meat, milk and eggs, the food triumvirate which is the basis of the American human diet.

There has been a notable increase in the numbers of cattle, sheep and hogs, and yet there is still an economic as well as a hunger deficiency in most livestock products.

Food experts were agreed that when the population of the United States reached 150 million (and it has now passed that mark) we would need, as against what we had on January 1, 1951, 10 million more milk cows, 11 million more beef cows, 8 million more sheep and lambs, 20 million more hogs, and 28 million more poultry units, if our dietary standards were to be kept up and in proper balance.

Grass being the basis of this livestock and poultry increase, must take on a big load of additional responsibility. It cannot do so unless the farmers of America become really grass conscious and get behind a comprehensive grassland program. If they do not, there will be a decided lack of grass on our dinner tables — a food situation that will have a



Grassland agriculture must needs be a mechanized agriculture. Tractors, balers, combines, like these Allis-Chalmers machines are typical

serious effect upon the health, prosperity, and happiness of our people.

There is no valid reason why steaks and lamb chops should be articles of human diet which, if the housewife filled her market basket in accordance with her weekly food budget, are practically relegated to a place on the mantlepiece, to be gazed upon in hungry wonder and with slavering human tongues, rather than occupying their rightful places every day on our dinner tables.

Grass and its processed products, hay and silage, are in reality not livestock feed. They are definitely human food, and the real measure of their nutritional values is not what they are capable of doing for the cow, horse or sheep, but rather what they will do by way of building more virile, healthy, human bodies. The grasses which once found their way into the paunches of horses and mules are now finding their way into human stomachs after being duly processed by the ruminants.

I like to think of grass as something to put on our dinner tables. Let us take the states of Iowa and Illinois, for example. These two states have a combined population of 11,652,648. The meat, milk, eggs, butter, and vegetables which go to make up an average standard individual diet — all of which are really grass — have a present-day value of 33 cents per meal which means that we find 1¾ million dollars worth of grass on the dinner tables of those two states every day, 365 days in the year.

Good soil produces abundant grass of high nutritional value, and that grass eventually finds its way to human stomachs.

If every human being could be made to realize that, were our corn, wheat, oats, rye, barley and rice crops to fail and we still had the grasses left, we could still live, but were the grasses to fail for a single year with no food reserves, the human race would starve or would become so emaciated that it is doubtful whether it could ever recover.

We can take a 150-lb man or woman and the same weight of good hay and we find the same elements in both — proteins, minerals, fats and oils, and carbohydrates. You can go to the corner drug store and purchase those elements for less than 2½ dollars and then make up the balance of the weight at the water tap. It makes one feel rather insignificant, but it is nevertheless a fact.

EVALUATE THE GRASSES IN TERMS OF HUMAN FOOD

When we begin to evaluate the grasses in terms of human food, their real intrinsic importance will be revealed, and the mechanization of the grass crop will receive a "shot in the arm," the reverberations of which will be felt around the world.

Our agricultural economy is being gradually built around a grassland agriculture. We have mined and exhausted much of our once fertile soil by overcropping with grain, corn and cotton, in order to fill our pockets, only to find that those pockets have developed holes through which much of the money we supposed we possessed has leaked.

Grassland agriculture is a corollary to a grain agriculture; in the sense that it is a "bonus" agriculture rather than an immediate cash crop agriculture; it is a flexible agriculture. It is the pivot point from which all other systems of agriculture can radiate with the least possible interruption to our economy. The American pioneer farmer started with grassland, and the farmer of today is rapidly beginning to realize that he must get back to grassland as the base upon which to build his other farming operations.

Grassland agriculture must needs be a mechanized agriculture. It requires the tractor to furnish the kind of power necessary to quickly convert the stubborn sod into seedbeds suitable to other crops when and where economy demands.

We have only just begun to furnish the tractor with a complement of equipment suitable to the job. I predict that great changes will be made during the next few years in the grass-handling equipment we now have.

The agricultural engineer of the future who wishes to have a part in these changes will have to be something of the botanist, the soil conservationist, the animal nutritionist, and the agricultural economist, plus a large bump of vision, in order that he may design the newer and better grass-handling equipment that will be needed.

The production of grass and legume seed was a topic which came up for considerable discussion at a national pollination conference which I attended at Ardmore, Okla., a few weeks ago. The main point at issue was how can we mechanize the job so as to do it more quickly and efficiently.

There is a grave shortage of certified grass and legume seed due largely to the fact that too little attention has been paid by the builders of farm equipment to machines which will sow all kinds of grass and legume seed at proper depths so as to give good stands. Then there are the harvesting problems attendant on grass and legume seed production and many grass and legume seeds such as ladino clover, bird's-foot trefoil, lovegrass and several others are taxing the abilities of present-day combines to the limit.

A speaker from the Production and Marketing Administration (USDA) told us at the conference just referred to that there is a shortage of legume seed at present of more than 50 million pounds with little likelihood that it will be met. When we consider that the prices of such seed vary from around 50 cents to $2.50 per lb, it can be realized where it fits into our economy.

SOWING GRASS SEED PRESENTS ENGINEERING CHALLENGE

The problems of grass and legume seeding are many. Let us consider two of the extremes in grass and legume seeds. The first is redtop seed which contains around 5 million seed per pound; the other is hairy vetch which contains around 16,000 seeds per pound. The redtop weighs 14 lb per bu. and the hairy vetch weighs 60 lb per bu. The engineers can well imagine being given the task of designing a grass-seed attachment for a grain drill which will give the recommended patterns for seeding both these seeds.

There is one more thing I would like to touch upon and that is the matter of pasture renovation.

It is conservatively estimated that there are in the United States around 200 million acres of permanent pasture which are badly in need of renovation, if we are to maintain our livestock quotas in keeping with population requirements. To massage the faces of those wornout pastures is no small job, requiring, as it will, a large amount of mechanical power, which we now have to the tune of about 180 million horsepower, as well as tools for pasture renovation which we do not have, except in the form of makeshifts from regular farm equipment. This opens up a most interesting field to the agricultural engineer by way of study and development of such tools. The field is wide open and practically unlimited.

From what I have said regarding grassland agriculture, I would not want to appear to be recommending that we should embark upon an all-out program of hastily converting our present corn, grain and cotton fields into grasslands. Such procedure would not develop a practical, sane grassland agriculture.

Grasses in hundreds of varieties grow almost everywhere. The grasses are not as ecologically sensitive as are the corn, grain and fiber crops, although ecology does play an important part with some of them. The course of change to a wider use of grasslands in our agricultural economy must be steady and not hysterical; it must be balanced with livestock on the one hand and a thorough understanding by the farmer of what he is doing on the other; it must be based upon a long-range program; it must be adapted to the particular needs of particular farms. The renovation of Kentucky bluegrass pastures, Great Plains range pastures, and the hillside pastures of Wisconsin and New York are very different operations and must be treated accordingly.

Grassland agriculture is rapidly coming to mean much more than merely increasing our grassland acreage. It means more meat, milk, eggs; a higher and less expensive standard of living than that which we now enjoy; a standard of living which can keep pace with the demands of our everincreasing population; it is a bulwark against soil erosion; it will increase future crop production and provide a more stable agricultural economy. Truly the agricultural engineer has an important part to play in the mechanization of its progress.

Brooding Poultry with Infrared Energy

By Vernon H. Baker and James H. Bywaters
ASSOCIATE MEMBER A.S.A.E.

THE brooding phase is probably the most important and the most critical period in the life of a chicken. The care that the young bird receives during the first four or five weeks of its life has a decided influence on its health, future usefulness and growth. Since poultry producers in Virginia and other states are looking for more efficient brooding systems, considerable interest is being shown in brooding chickens with infrared heat lamps. Some of the advantages of this system are as follows: (a) The initial cost is low, (b) chicks can be seen without moving any of the brooding equipment, (c) there is no brooder to occupy valuable floor space, (d) at the end of the brooding period the lamps may be raised up out of the way, making it easier to clean the house, and (e) the chicks may be kept warm with the infrared rays in a relatively low-temperature house.

Infrared-heat-lamp brooding may have the following disadvantages. (a) The cost for energy per chick may be higher when compared with conventional brooding, and (b) loss of light and heat due to power outages may cause the chicks to pile up and smother or chill.

The brooding of poultry with heat lamps is a relatively new idea. Yung and Mussehl (1)* conducted tests in 1940 on brooding chicks with infrared energy. Kennard and Chamberlin (2) of the Ohio Agricultural Experiment Station developed a hover-type brooder using heat lamps as a source of energy. Porter (3, 4), in 1944, suggested that heat lamps be used as a source of energy for postwar brooding research.

The Virginia Agricultural Experiment Station, in cooperation with the Division of Farm Electrification, U. S. Department of Agriculture, first started to brood chicks with infrared lamps in 1949 (5). This work was continued and expanded in 1950. Among the factors studied was the effect of infrared energy on the young chicken. This included observations of feathering, weight gains, and conditions of the exposed skin. The electrical energy requirements were recorded and the cost determined. Moisture patterns in various types of litter, under heat lamps, conventional electric brooders, coal and wood brooders were studied. The projected area of three different breeds of chickens was determined so that recommendations could be made as to the number of chicks that could be placed under a given lamp. Heat patterns for different lamps were also determined.

Method and Procedure. Laboratory tests consisted of determining energy patterns for the different types of heat lamps which included the type R-40, type G-30, and the ordinary incandescent lamp from each of three major lamp manufacturers. The arrangement and instrumentation for this work is shown in Fig. 1. A General Electric type DW-60 soler radiation meter was used to measure the radiant energy from the different lamps. The patterns for 125, 250, and 375-w type R-40 lamps are shown in Figs. 2, 3, and 4, respectively.

The projected area of the White Leghorn, White Rock, and New Hampshire was determined by photographing the chick at weekly intervals. The chick was placed on a calibrated floor area in a screen pen and was photographed from directly above. The average projected area for three chicks from each of the three breeds of chicks photographed is shown in Fig. 6. The area for each week was taken from the photograph with a planimeter.

The brooding work for 1949-50 was conducted in a 20 x 40-ft insulated quonset hut divided into 8 pens, 10 ft square. Measurements were taken in the four center pens for this study. A 375-w, heat-resistant, type R-40 heat lamp was suspended from the junction boxes above each pen down to the porcelain lamp socket. The lamps were placed about 18 in above the litter and raised 2 in each week after the second week until a height of 24 in was reached. The lamps remained on continuously for the first 8 weeks. During the latter part of the brooding period, the lamps were turned off during the day. One radiant-heat panel was installed in each end of the quonset hut to provide supplemental heat if needed. Necessary meters were installed to measure the electrical energy consumed. A hygrothermograph, mounted 4 ft above the floor, recorded the temperature and relative humidity at this point.

Thermocouples were placed inside black and white perforated ping-pong balls, Fig. 5, in an effort to obtain relative-heat patterns from the lamps in the four middle pens as the chickens grew. The ping-pong balls were covered with chick down from the hatcher in an effort to approximate the absorptive characteristics of a chick. The temperature at the various thermocouples was recorded with a 48-point recording potentiometer.

Aluminum conical-shaped hovers were first tried over the lamps. A mixture of 228† one-day-old chicks (consisting of equal numbers of White Leghorns, New Hampshires and White Rocks) were placed under each lamp in the center pens. These chicks remained under the heat lamps for about 9 weeks and then one-half of the brood was removed to unheated colony houses. In addition, Barred Rock, Dark Cornish

†This was about 40 per cent more chicks than should have been brooded in a 10 x 10-ft space, allowing 0.6 sq ft per chick.

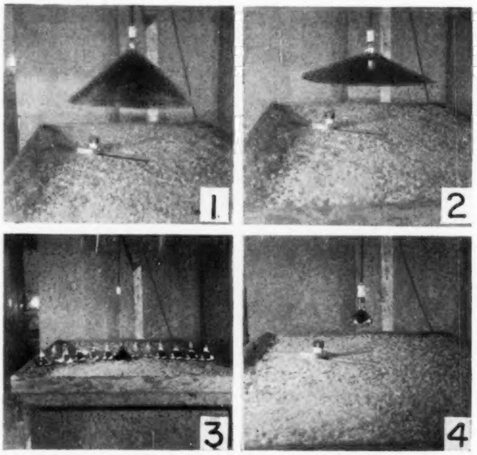


Fig. 1 Arrangement for radiation pattern determination for different heat lamps. (1) Type DW-60 meter mounted above litter on sliding scale under deep hover. (2) Shallow hover. (3) Lamps tested. (4) No hover

This paper was presented at a meeting of the Southeast Section of the American Society of Agricultural Engineers at Memphis, Tenn., February, 1951. The research project on which this paper is based was carried out in cooperation with the Division of Farm Electrification, U. S. Department of Agriculture.

The authors: VERNON H. BAKER and DR. JAMES H. BYWATERS, respectively, associate agricultural engineer and research poultryman, Virginia Agricultural Experiment Station.

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*Numbers in parentheses refer to the appended references.

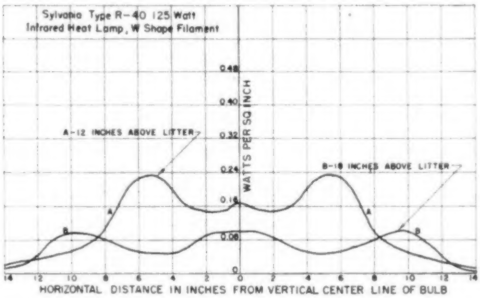

Fig 2 Radiant-energy distribution pattern for Sylvania Type R-40, 125-w heat lamp. Average of two lamps. Readings taken with type DW-60 radiation meter

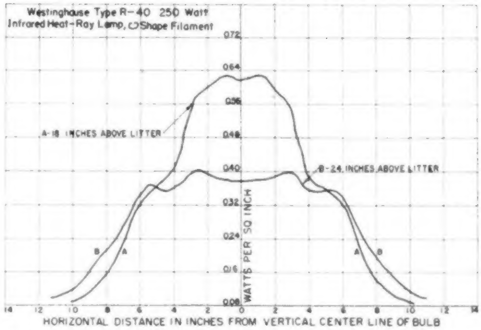

Fig. 3 Radiant-energy distribution pattern for Westinghouse type R-40, 250-w heat lamp. Average of two lamps. Readings taken with type DW-60 radiation meter

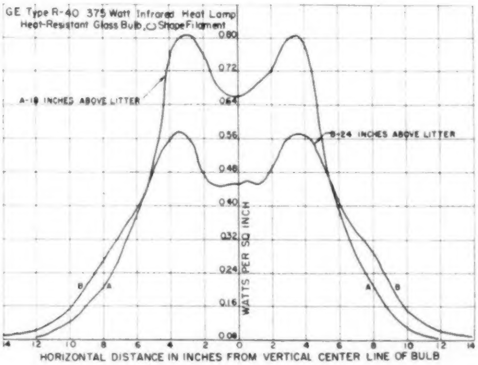

Fig. 4 Radiant-energy distribution pattern for General Electric type R-40, 375-w heat-resistant heat lamp. Average of two lamps. Readings taken with type DW-60 meter

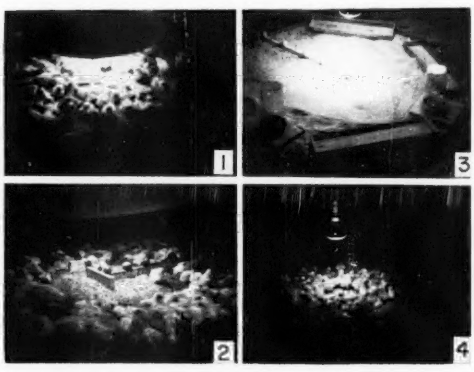

Fig. 5 (1) Shallow hover over lamp showing about 50 per cent of chicks eating and about 50 per cent under the lamp. (2) Chickens under the lamp in a doughnut-shaped ring with thermocouples in white and black, down-covered ping pong balls (3) Heat lamp above sand litter, feeding and watering containers in preparation for baby chicks. A 12-in-high barrier is erected around this area for the first week. (4) Chicks under heat lamp with no hover

and some crossbred chicks were brooded in the four end pens. At the start of the brooding, the bottoms of all lamps were placed about 18 in from the litter. At this height the maximum temperature under the lamp was about 120 F when the room temperature was 60 F. The high temperature area is influenced by the type of filament used in the lamp. One to two-weeks-old chicks seemed to seek a comfort range from 85 to 110 F. They generally arranged themselves in a doughnut shape with the high temperature area in the center vacant. The minimum room temperature fell below 35 F in two or three instances without any ill effects. When the temperature fell below 35 F, during the first week or two of brooding, the lamps were lowered to about 15 in above the litter.

The chicks were weighed at the end of 4, 8, and 12 weeks and the resulting weights compared with similar weights of the preceding brood, which was reared in a hot-water-type brooding house for 8 weeks and then transferred to coal and wood-burning colony houses for the last 4 weeks. Feathering, mortality, and feed consumption were also recorded.

During the 1950 season, two different types of litter were used, sawdust and sand. Sand was used in the heated area in two pens in the quonset hut and sawdust was used in the remaining two center pens. The litter was placed from 4 to 6-in deep over the vaporproof concrete floor in the quonset hut. Tests were also conducted using straw, ground corncobs, sawdust, and shavings for litter to determine a safe height above the litter in order to prevent fire.

RESULTS AND DISCUSSION

Lamps Available and Energy Distribution Patterns. Heat lamps are generally made in two different types, the G type and R type (6). The G-type heat lamp has a clear glass bulb and is similar to an incandescent bulb, but the filament operates at red heat instead of white heat. This type of bulb is used mostly in factories. Tests conducted with the type G-200-w bulb with the arrangement shown in Fig. 1 shows that a considerable amount of the radiant energy is directed toward the litter. The G-type lamp costs less than the R-type lamp; however, it is felt that better brooding results will be obtained with type-R heat lamps.

The R-type bulb has a built-in reflector which consists of a thin coat of reflective metal on the inside bowl of the bulb. Heat lamps are often designated as R-40 or R-30, the R means reflector type and the number following the R means the number of ⅛ in across the lamp. The R-40 lamp is generally used for brooding and may be obtained in three types—plain glass, heat-resistant glass, and red glass——and in sizes from 125 to 375 w. The heat-resistant glass is generally used where there is danger of water coming in contact with the bulb and the red glass bulb is used where there is need of filtering out some of the visible rays of light. Energy distribution patterns were obtained for the three R-type heat lamps. The life of these lamps is about 5,000 hr.

Energy patterns for the 125, 250, and 375-w type R-40 lamps are shown in Figs. 2, 3, and 4. The type R-40 lamp may be obtained with a filament of either the U shape or the W shape. The distribution pattern for the U-shape filament [Fig. 2, Fig. 5 (2)] is such that the chicks under the lamp tend to form a doughnut-shaped ring. The radiation pattern is essentially the same regardless of which type filament is used, but the comfort zone for the two lamps is not the same. Chicks under a lamp with the W-shape filament tend to find a comfort zone more uniformly over the heated area. One line of thought is that for best brooding results, the radiation pattern from the lamp should be umbrella shape, thus allowing more chicks under a given lamp. Another thought is that a lamp with an ice-cream-cone-shape pattern is desirable. This would allow a relatively hot area under the lamp and would give a temperature gradient so that the chick could seek a comfort zone to suit individual needs. With cold-room brooding, the chicks would come from eating and move over under the hot area to get warm, then they would move out from the heated area and seek a comfort zone for resting and sleeping. Up to 75 per cent of the energy from a heat lamp is radiated as radiant energy. The remaining 25 per cent is given off from the lamp and lamp socket as heat being carried by conduction by the air which flows past the lamp. The infrared energy warms the chicks without heating the air through which it passes, also the infrared energy which strikes the litter is changed into sensible heat which helps to keep the chicks comfortable.

The major effect of the aluminum reflectors used with the type-R lamps (Fig. 1) was to serve as a baffle to prevent convection currents from creating a draft around the heated area. Note in Fig. 5 (2) the chicks seem to form a large ring under the lamp with the reflector or baffle and in Fig. 5 (4) the chicks seem to stay closer to the center of the heated area. The lamps in both pictures were the same height above the litter with the same room temperature.

No abnormal therapeutic effects of erythema or sunburn, due to infrared rays on the exposed skin of the chicks, have been observed. Infrared radiations may be divided into three bands of three different wave lengths, namely: near infrared, 7,500 to 14,000 A; middle infrared, 14,000 to 25,000 A, and far infrared, 25,000 to 50,000 A (4, 7). One A (Angstrom unit) equals 1-250,000,000 in. The type DW-60 radiation meter used to obtain the radiation patterns (Fig. 2, 3, 5) was calibrated to indicate radiant energy with a wave length between 0.3 to 3.5 microns or from 2,952 to 34,448 A. Industrial literature (8) shows that the maximum radiation from an industrial infrared lamp, with a filament temperature of 2,500 K, occurs between a wave length of 7,000 and 20,000 A.

Chickens' eyes are susceptible to soreness caused by the short-wave ultraviolet radiation, and erythema (sunburn or tan) of the exposed skin of the chicken may result from receiving too much ultraviolet radiation (3). The ultraviolet output from ordinary incandescent lamps and heat lamps is so small as to be negligible for most purposes (9). What ultraviolet energy is radiated from the filament of the heat lamp would probably not pass through the glass portion of the lamp. Overexposure to infrared has been mistaken for erythema. Energy in the infrared range penetrates and heats subcutaneous tissues which, upon overexposure, causes reddening of the skin known as hyperemia (10). This condition disappears after the subject is removed from exposure to the source of infrared radiation.

Energy and Temperature Requirements. The energy and temperature requirements for poultry during the brooding period has been given much study. Some investigators believe that relatively high ambient temperatures are necessary during the brooding period. Others have had success with low temperatures. Seeger and Oliver (11, 12) reported that a group of chicks were brooded satisfactorily for two weeks (using infrared lamps) in a cold storage room at an ambient temperature of 12 F below zero. Martin (13) brooded chicks satisfactorily under a radiant heating panel at an ambient temperature of 10 F.

In an effort to determine the relative-energy requirements for three different breeds of chicks, 76 Barred Rocks, 76 New Hampshire Reds, and 76 White Rocks were placed under a 375-w heat lamp. The black chicks (Barred Rocks) tend to stay on the outer perimeter of the group of chicks. The White Rocks and White Leghorns grouped together closer to the inner area of the doughnut area, while the red chicks sought a position in between the chicks with black and white plumage. This pattern was more noticeable during the first week or two of brooding. After the chicks were almost feathered, the different breeds did not seem to be as particular for any one area as before feathering. These tests may indicate that the three breeds of chicks studied may require different amounts of energy and that the color, degree of feathering, and texture of feathers could have some effect on the energy requirements for the different breeds.

Fig. 5 (2) shows a group of chicks, age one week, that seems to be contented and resting under the heat lamps. The type DW-60 radiation meter was used to measure the radiant energy in watts per square inch just above the area where the chicks were comfortable, when the 375-w lamp was 18 in above the litter. The meter readings were 0.12 w per sq in for the outer perimeter of comfort and 0.40 w per sq in for the inner perimeter, with 0.24 w per sq in in the center of the comfort zone, which is approximately equal to the solar radiation of 0.28 w per sq in at Blacksburg, Va., on December 2, 1950, as measured with the DW-60 meter. The highest temperature recorded directly underneath the lamp was 130 F. The temperature inside the black ping-pong balls averaged about 20 F above the temperature inside the white ping-pong balls when the room temperature was about 50 F.

The normal routine of the chicks was to eat and sleep in shifts, 24 hr per day. About half of the chicks would be out eating while the others would be resting or sleeping. When the chicks got cold eating or drinking, they would jump over the other chicks [Fig. 5 (2)] into the heated area, get warm and then gradually move out to the comfort zone and rest.

The 375-w lamps used in the 4 test pens operated continuously throughout the first 8 weeks of the brooding period and were turned off during the last weeks of brooding as the conditions required. The radiant-heat panels in each end of the quonset hut were set at 60 F. The total energy required was between 2 and 3 kw-hr per chick for the heat panels and lamps combined. For the heat lamps alone there was about 2 kw-hr per chick consumed for winter brooding. This value would probably be lower for spring brooding.

The heat production and energy requirements for White Leghorns and White Plymouth Rocks has been determined by Mitchell and Kelley (14). Barrott and Pringle (15) have determined the energy eliminated by Rhode Island Red chickens by the use of a respiration colorimeter at Beltsville, Md. In the work by Mitchell and Kelley, the total net Btu required per 24 hr is equal to the sum of the energy expanded in basal metabolism, muscular activity, and energy equivalent to the gain in weight, or the energy acquired from the dry matter consumed. The total Btu production is the sum of the basal metabolism energy, plus the energy liberated in muscular activity, plus the energy increment due to feed. Estimates for the Btu required to maintain body temperature in excess of that furnished per degree drop below 62 F of environmental temperature has also been determined (14). The air temperature of 62 F is the critical temperature surrounding a fasting bird and is the temperature at which an increase in heat production must occur in order that body temperature may be maintained (16). For a chicken consuming food and moving about freely, there is an excess production of energy above the basal metabolism, at temperatures below the critical temperature of 62 F, which is available to maintain body temperature. The critical environmental temperature, from work referred to above, for active White Leghorn and Plymouth Rock chickens moving about and consuming the required amount of feed did not fall below 17 F.

Seeger and Oliver (11) have made calculations on the energy level required for chicks from one day to seven weeks old. They have extrapolated the data collected by Mitchell

and Kelley (14) on a curve and estimated the energy requirements from one day to four weeks of age. In their calculations it was assumed that fasting day-old chicks require about the same amount of energy for each degree below normal brooding temperatures as the ½-lb birds require for each degree below the fasting critical temperature of 62 F.

The above energy requirements for chicks from one to 70 days old was fitted to the equation $E = 2.92\, e^{0.0147t}$, where E = Btu per 24 hr per deg F below critical temperature and t = age in days. Suppose that it is desirable to estimate the energy requirements for a one-week-old chick with a brooder house temperature of 50 F. According to Barott and Pringle (18, 19) the optimum brooding temperature for chicks one day of age is 94 F which decreased 0.8 F per day for the first 18 days to 80 F on the 18th day and further decreased 1 F per day until a temperature of 66 F was reached on the 32nd day of brooding. Then the optimum temperature for brooding chicks one week old is 88.4 F. 88.4 minus 50 = 38.4 which is the temperature in the brooder house below the critical brooding temperature. By substituting the age of 7 days in the equation $E = 2.92\, e^{0.0147t}$, we get 3.23 Btu per deg below 88.4 F. Multiplying 3.23 by 38.4 we obtain 124 which is the Btu requirements per 24 hr for a one-week-old chick. By referring to Fig. 6, we find that the projected area of a one-week-old chick is about 6 sq in. Dividing 124 by 6 x 24 we get 0.86 Btu per sq in per hr, or 0.26 w per sq in of chick projected area as compared with 0.24 w per sq in of radiant energy at the center of the comfort zone, in Fig. 5 (2). Further calculations may be made using different brooder-house temperatures and different ages if desirable.

Projected Area and Surface Area. The surface area of the White Leghorn chicken has been determined by Mitchell (17) and is represented by the formula $S = 8.19\, W^{0.705}$, where S is square centimeters and W is weight in grams. This equation may be used to determine the area of a chick upon which radiant energy would be effective if the chick was at the center of a sphere and the energy was being radiated from the surface of the sphere to the chicken, or, in other words, if the energy was coming toward the chicken from all directions. However, this is not the case when chicks are brooded under a heat lamp. If two lamps are mounted so that the radiant energy is directed toward both sides and the back of the chick, the surface area of the chick, as determined by the foregoing method, would probably give an approximation of the chick area that would be affected by the radiant energy.

If the heat lamp is mounted vertically, it is felt that the area of the chick that would be affected by the incident radiant energy would be closely approximated by the projected area of the chicken. The projected area may also be used to estimate the number of chicks that could occupy a given area. The area of the White Leghorns, as would be expected, was lower than the White Rocks or New Hampshires. There is a small difference between the area of the White Rock and the New Hampshire which is probably due to the fact that the feathers grow closer to the body of the New Hampshire.

The projected area data shown in Fig. 6 may be used to estimate the number of one-week-old chicks that can be brooded under a given heat lamp. The zone of comfort of a 375-w lamp with a U-shaped filament 18 in above the litter was observed to be between 6 and 14 in from the center of the heated area. By dividing the area of the comfort zone of 507 sq in by the approximate average projected area of one-week-old chicks (6 sq in) gives us about 85 chicks. Allowing for the fact that the chicks overlap when resting and sleeping and that in their normal routine, from 40 to 50 per cent of the chicks were observed to be resting and remainder eating and drinking, it is believed to be safe to estimate that from 200 to 225 one-week-old chicks could be brooded with a 375-w lamp. This same lamp will take care of the chicks as they grow. As the chicks grow the energy requirements become less and the comfort zone becomes larger. The lamp is then raised in order to lower the energy on the backs of the chickens. By the same reasoning, with the use of Fig. 4 and a comfort zone of about 400 sq in, from 125 to 150 chicks can be brooded with a 250-w heat lamp. The area of the 16-in diameter comfort zone for the 125-w heat lamp is about 200 sq in when the lamp is 12 in above the litter. From 50 to 75 chicks can be brooded under this lamp. The chicks would not form a doughnut-shaped ring under this lamp because the energy level at the center of the lamp is not above the chick requirements. The lamp wattage per chick for the average number of chicks that can be brooded under the 375, 250, and 125-w lamps is 1.76, 1.82, and 2.00 w per chick, respectively. Summarizing the above, where the brooder-house temperature is not expected to go below 55 F, the estimated brooder capacities for the various lamps are 200 to 225 chicks for 375-w lamp; 125 to 150 chicks for the 250-w lamp; and 50 to 75 chicks for the 125-w lamp. If the brooder-house temperature falls as low as 40 F, the brooding capacity per lamp should be about 150 to 175 chicks for 375-w lamp, and 100 to 125 chicks for the 250-w lamp. The 125-w lamp will probably not be sufficient unless the room temperature is above 50 F. In the above calculations it is assumed that sufficient floor space is available to accommodate the chicks as they grow.

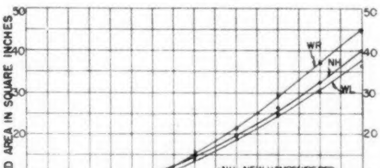

Fig. 6 Projected area of three breeds of chicks

Litter. The fine, clean, dry sand used for litter proved to be highly satisfactory. Sand is a good conductor of heat and it eliminates any danger of fire due to energy radiating on the litter. Sawdust was also satisfactory for litter. The average moisture content (wet basis) for sand was 8.2 per cent and for sawdust 13.5 per cent for the brooding period, which is considered dry litter. The average moisture content over the brooding period for the sawdust litter under the coal, wood, and conventional electric brooders was 12.3, 12.6, and 22.3 per cent, respectively. The litter was not changed during the brooding season.

Tests with the ground corncobs, straw and sawdust show that the straw and sawdust will ignite if a 375-w lamp radiates over an extended period from 6 to 8 in above the litter. The ground corncobs did not ignite when the 375-w lamp was 8 in above the ground litter, but they did become quite hot. Based on these tests the 375 and 250-w lamps should be mounted at a minimum of 12 (preferably 15) in above the litter and the 125-w lamp at a minimum of 12 in above the litter.

Physical Observations of Chicks. There is no present indication that infrared energy is harmful to chicks. There was no significant difference between chicks brooded with infrared or hot-water-type brooders, either in body weight or feathering. Some abnormal feathering was noted in one pen for the 1950 season; however, it is not believed that this was a result of infrared brooding. The mortality for infrared brooding was low or lower than with other types of brooding; being 2.8 per cent for 1949 and 5.9 per cent for 1950, at the end of 8 weeks. A part of this higher mortality was no doubt due to there being about 400 more birds brooded in this house in 1950 than in 1949.

Pullets from the infrared-brooded flock began to lay 2 to 3 weeks before their 1-, 2-, and 3-weeks-older sisters that were brooded with other systems. The chicks were kept contented during the brooding period by raising or lowering the heat lamps as they grew and as the temperature changed.

Wiring and Power Outages. If the infrared lamps are on

at full intensity throughout the brooding period, it is important that the rated voltage of each lamp be available at the porcelain socket at all times. When the voltage is lowered the amount of energy radiated is reduced. This is desirable in the brooding installation reported by Seeger and Oliver (11). A voltage lower than the rated value is not desirable if the energy level on the chicks is controlled by raising and lowering the lamp.

Chicks that have been under heat lamps all of their lives without a power outage may never have been exposed to darkness. When there is a power outage at night the chicks may become frightened and are likely to pile up and smother. If the outage is prolonged, there will be a loss of heat and a likelihood of further piling and smothering or chilling.

Portable heating devices can be used to supply emergency heat. When a large number of chicks are being brooded, it would be a safe investment to install some type of alarm and a standby lighting system that could be used during a power failure.

SUMMARY AND CONCLUSIONS

Chicks have been brooded successfully at the Virginia Agricultural Experiment Station for the past two seasons. Energy distribution patterns have been determined for available heat lamps. The temperature and energy requirements for brooding poultry were discussed. The projected area for three breeds of poultry and the brooding capacity for different lamps was determined. Based on the results of these investigations with infrared brooding, the following points appear to merit consideration:

1 Low initial investment for small broods. The average life of the different heat lamps is about 5000 hr, or about 30 weeks. The cost of labor for infrared brooding is less but cost of energy required may be higher when compared with other methods of brooding.

2 Energy required for winter brooding was from 2 to 3 kw-hr per chick with the lamps burning continuously for the first 8 weeks. This value can be reduced when a practical method of regulating the output of the heat lamps is developed.

3 The litter stayed dry through the brooding period and was not changed. Fine, clean sand proved to be satisfactory for litter in the heated area thus eliminating the fire hazard.

4 From the results of tests conducted, there was no danger of fire as a result of litter igniting if the heat lamps are placed 12 in or more above the sawdust, ground corncobs, and straw. At the beginning of the brooding period, the 375 and 250-w lamp is placed about 15 in above the litter and raised about 2 in per week until a maximum of about 24 in is reached. The 125-w lamp may be started 12 in above the litter and raised to a maximum of about 18 in. It may be necessary to keep the lamps at the minimum height above the litter for a week or two in case of low room temperatures.

5 Feeders and waterers can be placed in the heated area during the first week or two of brooding and the chicks can be seen at all times.

6 There is no big hover to occupy floor space. At the end of the brooding period, the lamps are raised up out of the way making it easy to clean the house.

7 Chicks will be kept more comfortable under heat lamps if a small baffle, similar to the hover used in these tests, is mounted above the lamp in order to prevent convection currents from creating a draft around the comfort zone. In order to prevent thermal shock and breakage of the bulb, the metal hover should not come in contact with the bulb.

8 Infrared brooding allows cool-room brooding which means that the disease problem should be less.

9 The chicks were observed to be healthy and contented with infrared brooding. Light was available so that they ate and slept in shifts 24 hr a day. They appeared to select the energy level best suited to their individual needs.

10 The mortality rate for this method of brooding was as low or lower than for other methods of brooding.

11 There were no significant differences in gain in body weight or feathering for chicks brooded with infrared when compared with chicks brooded with other systems.

12 Pullets from the infrared-brooded flock began to lay 2 to 3 weeks before their 1-, 2-, and 3-weeks-older sisters that were brooded with other systems. The desirability of early sexual maturity has not been fully established. Further research is planned on the effect of infrared brooding on the age of sexual maturity.

13 Some type of alarm and standby lighting service and portable heating units should be provided as insurance against power outages as a loss of heat and light may cause the chicks to chill or pile up and smother.

14 The brooding capacity for the various lamps was estimated to be approximately 200 to 225 chicks for the 375-w lamp; 125 to 150 chicks for the 250-w lamp; and 50 to 75 chicks for the 125-w lamp. These capacities are for a well-insulated house with insulated floors where the room temperature is not expected to be below 55 F for any great length of time. If the brooder-house temperature is expected to be as low as 40 F, the brooding capacity per lamp should be about 150 to 175 chicks for the 375-w lamp and 100 to 125 chicks for the 250-w lamp. The 125-w heat lamp will probably not be sufficient unless the room temperature is kept above 50 F. These recommendations assume that from 0.6 to 1.0 sq ft of floor space per chick is available.

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The Historical Background of Reclamation

By Orson W. Israelsen
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RECLAMATION is of world-wide interest and importance. It seems appropriate to give serious attention to water control for production of food and fiber in our time of growing population in many lands. Reclamation includes world-wide, three-phase, water-control activities as follows:

1 Development, storage, conveyance, and use of water in irrigation

2 Protection of root-zone soils from excess water and construction of facilities to drain water-logged soils

3 Prevention of soil erosion by control of water runoff and irrigation practices.

A comprehensive definition of reclamation, developed by Ayres and Scoates (2)* is presented in Fig. 1.

Water control for reclamation has been practiced through the centuries and special reference is given here to the enginearing features of reclamation as defined in Fig. 1.

Centuries of Reclamation. The antiquity of irrigation is evident from biblical references, for example:

"And he said, Thus saith the Lord, Make the valley full of ditches. For thus saith the Lord, Ye shall not see wind, neither shall ye see rain; yet that valley shall be filled with water, that ye may drink, both ye, and your cattle, and your beasts." (II Kings 3:16-17)

Irrigation had been established when the writing of history began. The British Society of Anthropology accepts as a fundamental doctrine that historically civilization followed the development of irrigation.

An ancient Assyrian queen, supposed to have lived more than 2,000 years B.C., is credited with directing her government to divert the waters of the Nile to irrigate the desert lands of Egypt. The inscription on her tomb is: "I constrained the mighty river to flow according to my will and led its waters to fertilize lands that had before been barren and without inhabitants."

This paper was presented at a meeting of the Pacific Northwest Section of the American Society of Agricultural Engineers at Yakima, Wash., October, 1950.

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*Numbers in parentheses refer to the appended references.

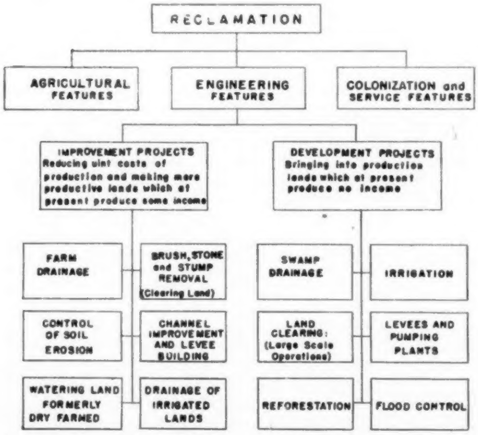

Fig. 1 Reclamation defined with respect to its agricultural, engineering, and colonization features

Since that time irrigation dams and main canals in Egypt have been constructed and maintained by the national government. Irrigation canals supposed to have been built under this Queen are still delivering water (15).

There are records of continuous irrigation for thousands of years in the valleys of the Nile, and comparatively long periods in Syria, Persia, India, Java, and Italy.

Genesis mentions Amraphel, king of Shinar, contemporary with Abraham, who is probably identical with Hummurabi, the sixth king of the First Dynasty of Babylon, having developed laws bearing the name of Hammurabi indicating that the people had to depend upon irrigation for existence. One of the laws of Hammurabi states that, if a man neglected to strengthen his bank of the canal and the waters carried away the meadow, the man in whose bank the breach had been opened shall render back the corn which he had caused to be lost.

Irrigation in China. In China, where reclamation was begun more than 4,000 years ago, the success of early kings was measured by their wisdom and progress in water development and control activities.

King Yu of Hsia Dynasty (2,200 B.C.) was elected king by the people as a reward for his outstanding jobs done on water control.

The famous Tu-Kiang Dam, still a successful dam today, was built by Mr. Li and his son in the Chin Dynasty (200 B.C.), and provides irrigation water for about one-half million acres of rice fields.

The water ladder, a widely used pumping device in China and neighbor countries, is believed to have been invented about the same time. Its inventor has been worshipped as a god by country carpenters.

The Grand Canal, 700 miles long, was built by the Sui empire, A.D. 589-618.

In modern times China is struggling with its reclamation problems. The gigantic Yangtze River Valley Authority project, designed by John L. Savage, an eminant American engineer, is comparable to Tennessee Valley Authority projects in the United States. The work in China was suspended because of civil war. The project will contain a dam, the largest in the world, which when completed will store water to irrigate about two million acres.

Drainage in England and Wales. England has for seven centuries, or more, been active in reclamation by drainage. In 1943 the productivity of more than 4,000,000 acres in England and Wales, approximately one-seventh of the total acreage used for agriculture, was dependent upon artificial drainage. This included reclaimable land subject to tidal overflow, but not a large acreage for which outlet was available at the individual farms. Of the total area dependent upon drainage in England and Wales, 2,892,000 acres were organized in drainage districts; the figure in 1942 was 10 per cent greater. More than 1½ million acres were in immediate need of drainage, of which one-sixth was included within drainage districts. Of the lands in immediate need of drainage, 1,279,000 acres were suffering from overflow caused by inadequate or obstructed arterial channels, while the other 476,000 acres could be improved by small drainage schemes for clearing main ditches and other small watercourses (10).

The earliest drainage authority in England and Wales appears to be that for Romney Marsh originating in a Commission of Sewers issued about 1252 under Henry III. The practice of issuing such commissions became permanent under the Bill of Sewers enacted in 1531. This bill gave these commissions powers which included authority to remedy annoyance, assess persons responsible, and seize property in arrears, but conferred no powers to execute new work. The Bedford Level Corporation was organized in 1661 to control the great Fen area. The Land Drainage Act of 1861 provided for

elective drainage boards. By 1927 there were some 361 drainage authorities.

The Land Drainage Act of 1930, the present drainage law of England and Wales, not only consolidates and amends prior legislation but also contains new provisions of great importance, which (a) created one authority for each drainage basin having management of all drainage from field to sea, (b) departed from the principle of assessing all the cost of drainage against land in proportion to direct benefits, and (c) established the principle of government grants-in-aid for drainage of farm lands.

The values of England's reclamation experience, and its 1930 drainage law, are evident from the fact that "from the summer of 1940 to the end of 1942 the land drainage division of the Ministry of Agriculture and Fisheries bought, and put on land drainage work, 400 small dragline excavators. About 500 similar machines owned privately and by drainage districts and catchment boards were likewise engaged. The government has attacked the drainage problem with an extensive program of maindrain construction and rehabilitation and of farm ditching, tile drainage, and mole drainage" (10).

Irrigation in India. An excellent review of irrigation in India, prepared by Alfred Deakin in 1893, contains the following statement:

"The practice of irrigation in India antedates the historical epoch by an indeterminate period. The Greek Magasthenes, ambassador of Seleukos Nikator at the court of Sandrokothos, near Patna, who wrote an account of India 300 years before Christ, says that then 'the whole country was under irrigation,' and very prosperous because of the double harvests, which enabled the people to reap each year. There are reservoirs in Ceylon and in Southern India more than 2,000 years old.

"As the real mission of irrigation in India is to maintain life, and its success lies in minimizing famine, it brings those who would sum up the case for and aganst it fairly face to face with an old problem of history, pertaining in some degree to all races, but especially under Asiatic conditions. Progress is readily measured, and at each census the totals of the Indian Empire are enlarged. In 1881 Lower Burma had 3,670,000 souls; in 1891 it had 4,450,000, or an increase of 21 per cent. It is true that this is partly due to immigration from India proper, but there, too, the totals have expanded. The prospect of a country doubling its population in five or ten years may appear at first sight matter for congratulation. It means peace and plenty, to some extent health and morality, increased production, increased consumption, increased trade, and increased wealth. All these can be predicted of India, whose total population for British and feudatory states alike was 256,000,000 in 1881, and was 286,000,000 in 1891. In the same period Australasia had added 1,000,000 as against this 30,000,000; and though the latter total has been swollen by annexation and improved methods of enumeration, the broad fact remains that the gain in 10 years exceeds the population of Italy or Prussia. Among the most potent means of this growth in the population is unquestionably the irrigation, which not only makes agricultural settlement closer wherever it obtains, but provides the vegetable food of the Hindus for countless thousands beyond the schemes. It may be held to have saved the lives of millions who would otherwise have perished, and to have enabled them to beget millions more, whom it now assists to maintain."

The expansion of irrigation in India during recent years has been greater than in any country except the United States. The reclamation works undertaken by the Indian government were forced on it by the terrible famines which periodically visit parts of this territory. Colonel Wace, commissioner of the Punjab, reported the prospects of the farmers of this part of the province in plain terms, which are generally applicable: "Their all," he says, "is staked on a rainfall, usually less than 20 in, and if that fails the heavens are brass and the earth iron, in a sense which only those know who have lived in those tracts at such seasons; the rivers are miles away; the cattle die of thirst as much as of hunger, and the people themselves have a hard fight for their lives, living on wild berries, grasses, and roots."

There have been seasons, such as in 1783, when even these foods failed, when the country became absolutely depopulated. The only real insurance against these evils is for each village to be provided a moderate irrigation supply. When this has been done, each village can stand on its own resources; men and cattle have sufficient food in bad years, and in good years abundance (8).

Reclamation in Italy. Irrigation and drainage are included in the reclamation projects of Italy, but the major problems have been in the drainage of the marsh lands (3).

The struggle against the marshes and malaria goes back to ancient times. In spite of the efforts of governments throughout the centuries, the Kingdom of Italy still found vast zones to drain and reclaim. Julius Caesar and Augustus, and later on a series of popes had set their hands to the task which was, however, never completed (7).

During the past two decades special efforts were made to reclaim the marsh lands in Italy. Concerning progress in these attempts the leaders wrote as follows: "Only three years ago there stretched the deadly marshes. We have waged a very hard battle. We had to face nature, material difficulties, and, moreover, the scepticism and mental inertia, the moral cowardice of those who before beginning the fight wished to be mathematically sure of victory, while for us the fight itself is more important than the victory. Because when the battle is begun with an iron will, it is unfailingly crowned with success" (7, p. 33).

Irrigation in Mesopotamia. Irrigation problems in Mesopotamia in the Euphrates and the Tigris River Valleys are very different from those in the Nile River Valley which is in flood from August to November and makes Egyptian irrigation easy. In Mesopotamia the flood-water season is from March until May, and this period is followed by burning rainless months of June, July, and August. Egypt for thousands of years was the home of basin irrigation; Mesopotamia for thousands of years was the home of perennial or permanent irrigation with great canals.

A long time ago the country was one of extreme desolation. The rainfall was only 5 in per annum, and the distinct feature of the landscape was the camel thorn. The only inhabitants of the desert lands were the indigenous tribes known as the Janglis, a people of pastoral and nomadic habits eking out a precarious existence by means of their camels and cattle. In such a land, irrigation has introduced many inhabitants, and the resurrection of the country was great.

According to Herodotus, Mesopotamia was studded with a large number of great cities. Crop production depended on irrigation water which was conveyed to the farms in many large canals. Grain commonly returned two-hundred-fold to the sower. The agricultural wealth of the country was outstanding.

Today the traveller contemplates a different landscape. The needs for reclamation of lands under the great rivers, Euphrates and Tigris, are now widely recognized. The government of Iraq is making special efforts to provide permanent reclamation facilities, and they are sending students to other irrigated countries to prepare for intelligent service in essential reclamation activities.

Irrigation canals in this country will probably be a success with efficient drainage of the irrigated lands. There are appreciable quantities of alkali salts in the waters of both rivers. One has only to inspect the irrigated tracts served by the lower reaches of the canals to see the damage done by irrigation without adequate drainage.

The outlook for further reclamation — especially irrigation and drainage — and for production of food for many more people is now considered very favorable.

Reclamation in the Western Hemisphere. The Spaniards on their first entrance into Mexico and Peru found elaborate provisions for storing and conveying water supplies which had been employed for many generations, the origin of which was almost lost even to tradition.

Drainage in Eastern United States. The productive capacity of millions of acres of land in the humid regions of the United States has been greatly increased by drainage during the past century and a half. The first noteworthy progress in drainage was made by John Johnson, frequently designated "the father of tile drainage," when he installed the first tile drain in the United States in 1835 (2). In only 10 years thereafter, nearly 900 acres of land in Central Park in New York City were successfully drained. Since that time progress in drainage in the humid regions has been especially noteworthy. Approximately 80 million acres in the U.S.A. are made productive by drainage, both with tile and with open drains.

Irrigation in Western United States. The prehistoric Indians of the Southwest practiced irrigation. In the Casa Grande National Monument in New Mexico traces of the ditches they dug to convey water to their fields can be seen. The early Spanish missionaries brought from their Mediterranean homes knowledge of irrigation. They watered, from nearby streams, gardens and fields around their missions in California, Arizona, New Mexico, and Texas.

Modern irrigation in the United States dates from July 24, 1847, when followers of Brigham Young broke desert land in Salt Lake Valley, Utah, diverted the waters of City Creek, irrigated the lands, and planted potatoes.

In less than 15 years these pioneers established 752 irrigation enterprises to supply water for 402,237 acres of land, according to the census of 1860. These irrigated areas were the major sources of food supply for the half-million persons who by 1860 were living in the area now included in the 11 states of the Mountain and Pacific group.

They did an excellent job, those pioneers, and by the turn of the century approximately 9,500,000 acres of land were being irrigated by some 20,000 enterprises and irrigation works representing an investment of a quarter of a billion dollars.

The Yakima Valley, in the State of Washington, is a part of the 4 per cent of western land that may ultimately be irrigated, and Yakima River flows 175 miles through this open valley, rich in plant food, to join the mighty Columbia. Little rain fell here, and in early days nothing but sagebrush grew. Man came, diverted the stream flow, developed irrigation and now many thousands of people are living on irrigated acres where almost none had homes before (18).

These homes cluster among the apple orchards of high production. There is in the volcanic ash, the sunshine, and dry weather that which gives these apples a rosiness of cheek, a firmness of flesh, and a keeping quality that have carried them into the market places of Yokohama, Rio de Janeiro, Cairo, and Danzig on the Baltic. The baled hay and the big baking potatoes from these farms supply non-agricultural activities all about. A city of nearly 40,000 people and a score of thrifty towns prosper where but yesterday sagebrush was supreme.

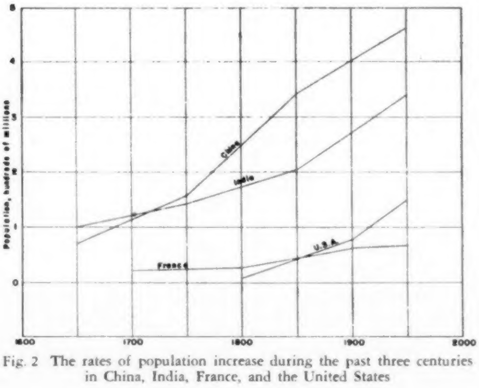

Fig. 2 The rates of population increase during the past three centuries in China, India, France, and the United States

In the deserts of Arizona, as a dot in a waste that is unbroken between El Paso and Los Angeles, lies the Salt River Valley. Here in the beginning an erratic stream came out of the mountains, sometimes ran a roaring torrent but mostly seeped into thirsty sands. Some rugged frontiersman, in the seventies, led a ditch from Salt River onto the desert and demonstrated the heavy yields where water is wedded with the desert soil. Ditches became canals, and Salt River Valley grew up to the water line which they established.

But the water supply was irregular and floods ripped out diversion dams. The U.S. Government nearly 50 years ago began its first great demonstration of welding mountains together, impounding flood waters, distributing them as needed, stabilizing the behavior of torrents, setting them to spinning turbines, and developing communities under these new influences (18).

This enterprise has transformed the cactus-studded desert solitude into an intensively farmed, highly productive, cosmopolitan community. Farming such lands as these has called forth great skills. Early lettuce goes out in refrigerated trainloads. Single acres have been known to produce 700 boxes of grapefruit. Alfalfa, heritage of the early Spanish fathers, yields six crops a year. Date trees ripen their honeyed fruit in the city parks. Long-staple Egyptian cotton surpasses the cotton picked along the Nile. Production per acre on these irrigated lands of the warm Southwest surpasses that known in many parts of the world.

Where the Rio Grande runs through New Mexico the early Spaniards developed a ditch here and there, and built scattering adobe homes. The U.S. Bureau of Reclamation built one of the most massive of its concrete dams across the Rio Grande at Elephant Butte, stored the floods, induced a steady flow, and brought prosperity to peaceful, semi-Latin communities that fringe the river for 150 miles.

The Snake River winds its tenuous way through Idaho and Oregon carrying much water and inviting man to apply his ingenuity to it. He has responded by construction of storage, diversion, and distribution works in the Snake River Valley, and as a result nearly a half million people live where before there was but little of value.

Irrigation Permanence Questioned. In spite of the outstanding irrigation progress made during the first one-half century of modern irrigation in the arid West, leading citizens and officials of the humid regions questioned the permanence of irrigation and pointed out irrigation failures in the Orient as a basis for their lack of confidence in agriculture under irrigation. In the western states, however, engineers, agronomists, farmers, and public leaders expressed their genuine confidence in the stability of the foundations of irrigation and in the permanence of irrigation agriculture in arid regions. Typical of this confidence, one of Utah's leading citizens, A. F. Doremus, former state engineer said: "Born of obscurity and despised as menial, irrigation has grown to be king of the rapidly developing West, and by virtue of its power to bless and benefit mankind, it has compelled the respect and admiration of all. Its promise is potent, its progress sure."

Population Increases Make Reclamation Urgent. During recent centuries, in many countries there have been substantial population increases. In some countries the preparation for increased population has unfortunately been neglected. During years of low precipitation, hunger, starvation, and death have stalked the lands. To avoid the seriousness of inadequate food supplies people everywhere may well adopt the slogan "reclamation prevents starvation." Population increases for the last 300 years in China, France, India, and the U.S.A. are presented in Fig. 2. The three countries which show major population increases, have made major reclamation advances during this 300-year period. Compared to these three countries which now irrigate nearly two-thirds of the world's irrigated area, many of the older countries have given but little attention to reclamation. For France the lack of reclamation is typified by small population increases.

Reliable information concerning irrigated areas in all countries during decades past is not available. However, data are presented for the United States and India in Fig. 3. Both

countries have made very substantial increases in reclamation areas. The United States of America, like India, is now determined to provide, by expanded reclamation, adequate food supplies for increasing populations. New acreages and supplemental water supplies proposed for development by the U.S. Bureau of Reclamation (16) in its program for 1948 to 1954 are presented in Table 1.

TABLE 1. PROPOSED IRRIGATION DEVELOPMENT OF NEW OR VIRGIN LANDS AND SUPPLEMENTAL WATER FOR LANDS NOW IN IRRIGATION PROJECTS WITH INSUFFICIENT WATER

	Acreage	
Year	New	Supplemental
1948	142,000	48,000
1949	183,000	12,000
1950	137,000	144,000
1951	106,000	499,000
1952	343,000	889,000
1953	489,000	1,067,000
1954	636,000	948,000
Total	2,040,000	3,610,000

This proposal provides for a total increase of 2 million acres of irrigated land. In order to achieve these results the annual expenditures will range from 204 million dollars in 1948 up to 682 million dollars in 1953, the total for the period being nearly 4 billion dollars.

World Food Supplies and Reclamation. The study of the historical background of reclamation, summarized herein, supports the conclusion that reclamation contributes to the perpetuation of world food supplies. Complete water control for irrigation, drainage, and prevention of erosion of soils is essential toward perpetuating agriculture in both arid and humid regions.

Great progress must yet be made in the advancement and application of irrigation and drainage sciences in order to maintain permanent civilizations in arid regions. The basic relations of irrigation to climate need to be clarified and more fully used; persistent efforts toward the solution of water storage and silt problems are essential; and more intelligent and widespread use of underground water storage is necessary. Efficient conveyance of water and its application to farms with a minimum of waste and injury to soils thus far have not been given adequate attention by public research agencies. Water requirements of crops on different soils as related to permanence of agriculture are more clearly understood than in the past decades, partly because of its fuller development, and also because of the gratifying progress in the advancement of scientific methods of estimating and measuring the consumptive use of water as influenced by irrigation practices (6).

An awakening of all of us — everywhere — to the fact that permanence of agriculture in arid regions depends vitally on more complete development of reclamation in relation to erosion control and in relation to the solution of the alkali problem on irrigated lands by more intelligent irrigation and drainage practices is evident. Outstanding scientific research concerning these problems has been initiated by public and private agencies in the United States of America and in other countries. A complete understanding of the interrelations of soils, water, plants, and soil moisture, and of the influence of these relations on intelligent irrigation practices, so essential to the reduction of water losses, to the prevention of waste of water and of waterlogging soils, and to the perpetuation of a permanently profitable irrigation agriculture, is the major objective of urgently needed systematic irrigation and drainage research.

Perpetuating Civilization. The challenge of perpetuating agriculture and civilization confronts both statesmen and scientists, but the way to meet it is clear. They must continue and enlarge the development of the sciences and their applications to reclamation. They must allot liberal proportions of their funds, their intelligence, and their energies to studies of permanence of water-storage structures and reservoirs, and to

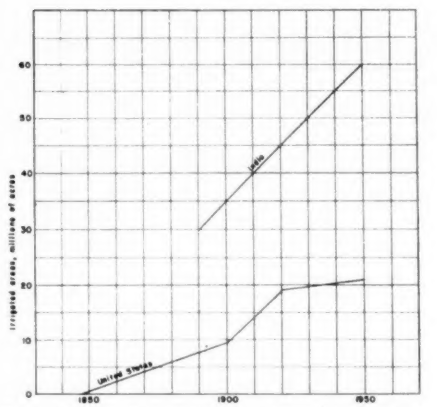

Fig. 3 The rates of increase in irrigated acres in India and the United States

methods of water conveyance, application, and use that will assure perpetuation of soil productivity, prevention of soil erosion, and mastery of the salinity and alkali problems. Wise use and preservation of natural resources, and effective control of water, guided by science in all of its branches, will insure the perpetuation of reclamation to the permanent advantage and welfare of civilization.

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Farm Drainage — An Important Conservation Practice

By P. W. Manson and C. O. Rost
MEMBER A.S.A.E.

RESEARCH has proven farm drainage to be a valuable conservation practice making possible a farm-management program that will better conserve and improve our farm soils and make better use of the water that falls on the farm. In addition, good farm drainage is a sound investment that pays the farmer substantial dividends in the form of increased yields and better land utilization.

There are no experimental data to support claims, currently circulated, that farm drainage is using up our ground-water supply, changing the pattern of our rain and snowfall, causing excessive floods or droughts, endangering the productivity of the soil, causing an increase in the corn borer population, or is stripping the top, fertile soil from the land. On the other hand, there is much experimental evidence which shows the value of properly installed drainage systems as these affect crop yields and soil management.

In 1835 tile drainage was first practiced in the United States. It is now estimated that about 80 million acres of our most productive land is associated with drainage enterprises. Farmers in Europe and Asia have been improving their lands by drainage for many centuries. With but few exceptions, the low wet lands on the farm, when properly drained, can be classed as some of the most fertile and productive acres on the farm. For instance, Webster soils, which are common to Minnesota, Iowa, Indiana, and Illinois, when properly drained are rated as the number one corn land of the United States.

Our Water Problem. Whenever there is a drought period, whether it be for weeks or for years, farm drainage is often blamed for lowering the ground-water table to exaggerated depths and some critics go so far as to claim that drainage causes droughts.

This paper was presented at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1950, as a contribution of the Soil and Water Division.

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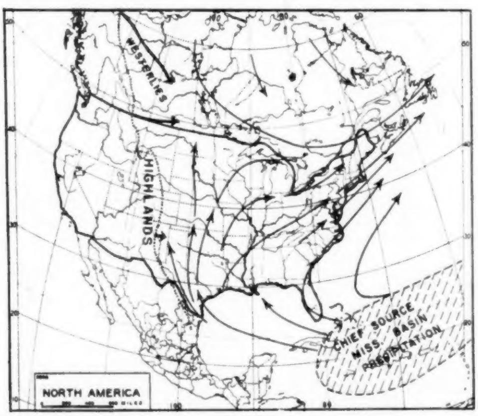

Fig. 1 Streamlines show summer resultant mean flow of air across the United States east of the Rocky Mountains at gradient level. It is estimated that the maritime winds originating east of Florida furnish most of the precipitation for the Mississippi River basin

Geologists report that for the country as a whole there is no progressive decline of the water table. Serious local water shortages may be aggravated by pumping the water from the ground for irrigation, cooling, industrial, or municipal purposes, at a rate greater than that which the ground-water sources can normally replenish the supply through natural soil flow. The need of more water on the farm plus the ease with which water now can be pumped has increased the per capita consumption about four times in the past 30 years. Many farm wells located in low-yielding water strata are said to be going dry when actually the well cannot yield the water fast enough to meet the increased demand. It should also be remembered that shallow wells are often affected by prolonged wet and dry periods.

Minnesota averages 25.4 in of precipitation from rain and snow each year. About 21 to 22 in of this will be lost by evaporation and transpiration. The disposition of the remaining 3 or 4 in is through runoff and deep seepage, thus serving to replenish the ground water and maintain the lake levels. The annual runoff from western Minnesota will average less than one inch while for eastern Minnesota it will average about 8 in. In addition, little water flows into Minnesota from outside its boundaries. Successive dry years inevitably reduce ground-water and lake levels, and reduce crop yields. Normal precipitation, however, soon recharges soil with water and raises lake levels and stream flow.

Source of Precipitation. The greater part of the precipitation that falls on the earth's surface originates from ocean sources. It is estimated by some hydrologists(1)* that 80 to 90 percent of the precipitation occurring over the United States east of the Rocky Mountains originates from ocean evaporation. The percentage of precipitation from maritime air increases toward the south. Toward the north the reverse will be the case. For Minnesota, or other north central states, the per cent of precipitation due to maritime air may be as low as 60 to 70 per cent.

The approximate location of the chief ocean source for the Mississippi basin precipitation is shown in Fig. 1. Maritime winds laden with moisture move westward over the Gulf of Mexico, then northward and eastward over the United States. The paths of these Gulf winds in the vicinity of Minnesota, like other states of the area, are somewhat regulated by westerly winds(2). The general droughts in this area can be traced to the force exerted by these westerly winds in diverting the moisture laden air to the south and to the east. This drought phenomena is common to many areas. It is estimated that these ocean winds that sweep over the Mississippi River basin are responsible for about 27 in of the average annual precipitation (29.6 in) in the Mississippi River basin. The remaining 2 or 3 in of basin precipitation is derived from land sources. Most of the water that moves into the air from land evaporation and transpiration, about 23 in annually in the Mississippi basin, enters the continental and maritime air masses and is carried back over the ocean.

Since only a small proportion of our precipitation is land-derived, drainage, or any other farm practice, will have but a comparatively slight effect on the precipitation pattern. It is true that precipitation may vary from year to year, or century to century, but such variations are a direct result of hemispheric conditions and are not man-made.

It is estimated that the maritime winds lose only about 20 per cent of their annual moisture charge in traveling across the Mississippi basin. It is the hope of some scientists that extra water can be squeezed out of the water-carrying clouds by artificial methods before the clouds again return to ocean areas.

The annual precipitation chart (Fig. 2) for the St. Paul—Minneapolis area in Minnesota covering 113 years, shows no

*Numbers in parentheses refer to the appended references.

connection between drainage and precipitation. Many of Minnesota's severest droughts occurred where drainage was not widespread and before drainage was practiced. The Minnesota droughts before 1900 could scarcely be attributed to land drainage.

There is further evidence, too, that dry weather is not new. Records from the nation's oldest weather stations and precipitation records based on tree-ring charts dating back over 500 years definitely prove this. Long-time precipitation records indicate that there are certain sections of the country where dry and wet years tend to run in series, not cycles. Such series, however, are so unpredictable that at this time meterologists cannot be certain of long-range forecasts.

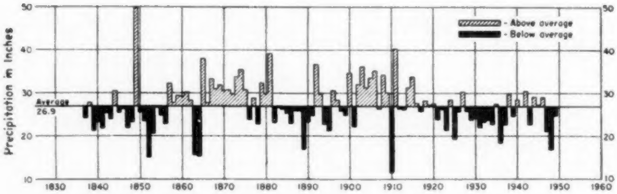

Fig. 2 Annual precipitation record, 1837-1949, at the U.S. Weather Bureau Station, Minneapolis, Minn.

Theory Of Farm Drainage. The purpose of drainage is to control soil moisture in order to increase yields and to improve crop quality by removing excess water from the upper 3 to 4 ft of the soil as quickly as is economically possible. There are three kinds of soil water:

1 Hygroscopic — the water held so tightly as a thin film around each soil particle that the plants cannot use it.

2 Capillary — the water that is loosely held around each soil particle as a result of capillary attraction. It is from this film of water that plants receive the water and most of the nutrients necessary for normal growth (Fig. 3).

3 Gravitational — the water in excess of the capillary water which is removed under the force of gravity. It fills the openings between the soil particles and granules that hold the capillary water. Removal by gravity may be so slow that it becomes harmful to plant growth since it excludes air which is essential to roots and this restricts root growth. Gravitational water will collect as free water in an open hole (Fig. 3).

Ground-water levels as they relate to agriculture are measured by the distance from the ground surface to the water surface in an open hole. In most agricultural areas in Minnesota, this ground-water level generally ranges from the ground level to a depth of about 10 ft. Since this water near the ground surface has little relationship to deep ground-water levels, geologists refer to it as the "perched" water table. The perched water table is usually separated from the deeper layers of water by impervious or slowly pervious subsoils.

Artificial drainage does not disturb or reduce the useful capillary water which is so essential to plant growth. It only removes the excess gravitational water which restricts root extension and excludes air which is essential to root growth. Because of this, a mineral soil suited to agriculture cannot be overdrained. In fact, during a drought a tile-drained soil may actually produce better crops than a similar soil not so drained. Under tile drainage any excess water is promptly removed so that crops develop a healthy and vigorous root system. On an underdrained soil the development of roots may be restricted by surplus water in the spring or by heavy rains which saturate the soil (Fig. 4).

A completely saturated fine-textured soil may contain the equivalent of 6 in of water per foot depth of soil. Of this only one-half to one inch is gravitational water that can be removed by drainage. Expressed in another way a half inch to one inch rain falling on a heavy soil carrying moisture up to the capillary capacity may cause the perched water table to rise about one foot.

The lateral movement of water through the soil is relatively slow. For that reason the beneficial effects of a tile line or an open ditch will seldom exceed 50 to 100 ft on either side of the drain. Capillary water movement tends to be vertical but its movement is usually slow. Because of this it is doubtful if the upward movement of capillary water can supply plants with any considerable amount of the moisture needed for growth. Crops are almost entirely dependent on the capillary water of the root zone.

Most successful irrigation projects include the installation of tile drainage systems. They are essential for two reasons. In the first place, they provide for the prompt removal of any excess of gravitational water and prevents water logging. The other reason is to remove the alkali salts which tend to accumulate when the soil water is removed by transpiration and evaporation.

Benefits Of Drainage. There is no evidence to indicate that land drainage may endanger the productivity of the soil. There is a good deal of evidence to show that it has many benefits when installed in situations where an excess of water occurs at some time during the year. A number of the benefits are listed below:

1 It permits better aeration of the soil which is essential to root extension and root growth.

2 It makes conditions favorable for the development of beneficial soil organisms. The oxygen of the air as well as suitable moisture conditions are essential for their growth.

3 On underdrained soils yields are increased and crop quality improved.

4 The length of the growing season is increased since earlier planting is possible.

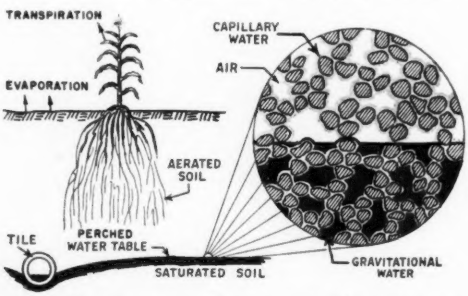

Fig. 3 This enlarged section of soil shows the difference between capillary and gravitational water

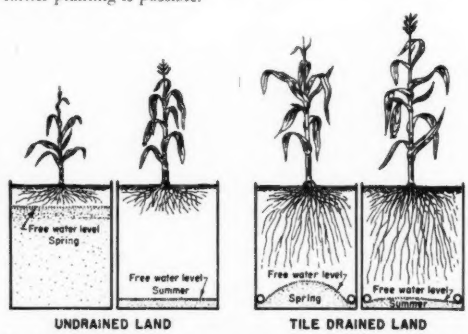

Fig. 4 Root development of plants grown on drained and undrained soils. Root growth is restricted to the soil area above the "perched" water table. When water recedes after a long wet spell, root extension is usually limited

5 The capacity of the root is increased since there is no interruption of root growth by excess water.

6 It permits the use of flexible crop rotations and better soil-management practices.

7 Drainage may add highly productive acres to the farm without extending its boundaries.

Drainage And Ground-Water Levels. The Minnesota Agricultural Experiment Station has studied ground-water elevations relative to farm drainage in Minnesota for more than 30 years. These investigations show that the perched ground-water table may be lowered on drained areas at the rate of about 1 ft in 24 hr, requiring some 3 or 4 days to lower the water to the tile depths. On the other hand, on undrained areas, the free water in the soil will recede at a much slower rate so that a rainless period of several weeks may be required to cause an equivalent drop in the water table. Thereafter, if no precipitation falls, the groundwater table will recede below tile lever at the same rate on the drained and undrained land. This rate of drop below the tile depth on drained and undrained land may range from one to several inches per week during drought periods or winter months when the ground surfaces are frozen. At these deeper soil depths, the loss of water by evaporation and transpiration is slow. During the spring months precipitation is generally sufficient to bring the perched water table on poorly drained lands back near the ground surface where it interferes with the growth of plants. Present knowledge indicates that farm drainage does not materially alter the runoff or the soil-water storage capacity of the better agricultural soils and has little effect on the deep ground water.

Drainage Important To Conservation. Besides improving the soil-moisture conditions in the root zone, farm drainage today is an important part of our soil and water conservation program. By improving the yields from flat, wet acres, the slopes where erosion may be serious can be planted to soil-saving and water-conserving crops. The high yield from one acre of flat land when properly drained may release several acres of sloping land for grass or forest cover.

In southern Minnesota and many other sections of the corn belt area, nearly every farm has a drainage problem. Data based on the U.S. Soil Conservation Service observations indicate that a high per cent of the farm plans reviewed in Minnesota have drainage problems involved. On many farms it is not possible to set up a crop rotation that will conserve soil and water and maintain an adequate supply of soil organic matter, without draining wet areas that are present on the farm.

Runoff Studies. Rain and snow are disposed of by surface runoff, subsurface runoff, evaporation, transpiration, and deep seepage. If artificial drainage appreciably decreased deep seepage, then runoff from drained areas would be greater than before drainage.

A classic study by Sherman M. Woodward and Floyd A. Nagler(3) of the University of Iowa indicated otherwise. The study included 10,000,000 acres in the Des Moines River watershed and 2,000,000 acres in the Iowa River watershed. The drainage operations on these watersheds included installations of tile drains and open ditches and some straightening of stream channels.

One-third of the total area of both watersheds was drained. In the Des Moines watershed there was one unit of 4,000,000 acres that received 67 per cent of complete drainage, and another unit of 2,700,000 acres that was completely (100 per cent) drained. The monthly precipiation for this study ranged from 0.88 to 9.96 in.

The authors concluded that during flood period there has been no significant change in the behavior of these two streams which may be attributed to drainage.

A quotation from the summary states: "The total runoff from storms of like precipitation, the maximum rates of discharge, and the rainwater storage conditions within the basins seem to have been unaltered by extensive drainage."

This research definitely indicates that the drainage of large areas of farm land similar to southern Minnesota or northern Iowa does not materially affect the water-storage rate of the area. There are a few exceptions such as isolated swamps, ponds, or small lakes, which are so perched on, or near, porous soils that they may have appreciable effect on the surrounding ground water. Likewise, drainage ways installed near open bodies of water can lower the level of the water if the surrounding soil is porous.

In addition to ground-water investigations in the farming areas of southern Minnesota, automatic water-stage recorders were installed in the peat areas of Aitkin, Beltrami, and Roseau counties, located in northern Minnesota.

These studies, like others, indicate a close correlation between the height of the perched ground-water table and precipitation. Except under unusual conditions, low or high perched ground-water levels fluctuate with the amount of rain and snow. Even during the droughts of the 30's few water-table depths for the bogs of northern Minnesota were recorded as low as 6 ft below the surface.

Since in Minnesota, like some other states, precipitation is somewhat limited, water-conserving practices must be observed that will tide us over water shortages that may occur during drought periods. Much deep-well water is now pumped for cooling purposes in many cities. This water is then discharged as surface runoff. Some day it may be necessary to return this water to the same ground strata by closed conduits after it has been used to better maintain the deep-water supplies. This is now being done in some municipalities.

Most state conservation departments are doing a fine job of controlling lake levels through the use of water-control structures. U.S. Army engineers are maintaining uniform stream flow through storage reservoirs. Soil conservation practices not only hold the fertile soil in place but also make possible the better use of rain.

Not all wet land should be drained. Since drainage is expensive, the benefits must be carefully weighed against the cost. If there is question about the productivity of the soil, the best procedure for having soils tested should be followed. It is good economy to hire the best drainage engineer available to evaluate the problem.

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Draintile Specifications Revised

TENTATIVE Specifications for Drain Tile are in publication by the American Society for Testing Materials under ASTM designation C4-50T. Specifications on this item were adopted as standard by the ASTM in 1914, and revised in 1916, 1921, and 1924. In 1950 it appeared that further revisions should be made. Revised specifications were drafted by the appropriate ASTM Committee C-15 on Manufactured Masonry Units. The Administrative Committee on Standards then, in September 1950, acted to place the specifications in tentative revised status for use pending adoption as standard. Suggestions for further revisions should be addressed to the ASTM at 1916 Race St., Philadelphia 3, Pa.

As published, the tentative specifications cover standard and extra-quality classes of draintile made of shale, fire clays, surface clays, or portland cement concrete. The specify chemical requirements and tests, physical test requirements, permissible variations of individual test, inspection; testing, inspection, and rejection; and physical test methods. In the tile size ranges from 4 to 12 in, minimum average crushing strength for the standard grade is 800 lb per lineal foot using the three-edge bearing test method or 1200 lb, using the sand bearing method. For the extra-quality grade these values are 1100 and 1600 lb.

APPLICATION OF HYDRAULIC REMOTE CONTROL TO FARM TRACTORS AND TRAILING-TYPE FARM IMPLEMENTS

(NOTE: This is a proposed revision of the above-titled A.S.A.E.-S.A.E. Standard adopted in its original form in March, 1949. The complete standard was developed by the Advisory Engineering Committee of the Farm Equipment Institute and is recommended to A.S.A.E. for adoption. It is published here to give A.S.A.E. members an opportunity to review it critically. It will shortly be adopted as an official A.S.A.E. standard, unless substantial objections thereto are raised.)

Proposed Revision of A.S.A.E.-S.A.E. Standard

APPLICATION

Hydraulic remote controls for all general-purpose and other farm tractors with a work capacity up to 6000 lb maximum drawbar pull shall include a cylinder with 8-in working stroke. Trailing-type hydraulically controlled farm implements intended for use with such tractors shall provide standard mounting points and clearance space for this cylinder.

Hydraulic remote controls for farm tractors larger than the above, up to those with a work capacity of 11,000 lb maximum drawbar pull shall regularly include a cylinder with 8-in working stroke. Trailing-type hydraulically controlled farm implements intended for use with such tractors and requiring an operating thrust within the capacity of an 8-in-stroke cylinder, shall provide standard mounting points and clearance space for this cylinder. Manufacturers of such tractors shall, however, make available cylinders with 16-in working stroke for use with implements for which an 8-in-stroke cylinder is inadequate. Implements requiring a 16-in-stroke cylinder include deep-tillage plows, 5-furrow moldboard plows, heavy-duty disk plows, deep-tillage tool carriers, and offset disk harrows, 9-ft cut and over.

Hydraulic remote controls for all farm tractors with a work capacity above 11,000 lb and up to 20,000 lb maximum drawbar pull shall include a cylinder with 16-in working stroke. Trailing-type hydraulically controlled farm implements intended for use with such tractors shall provide standard mounting points and clearance space for this cylinder.

Since most implements intended for use with tractors having a work capacity over 20,000 lb maximum drawbar pull are regularly provided with one or more suitable cylinders, they impose little requirement for the interchangeable use of hydraulic cylinders. For this reason, hydraulic controls for such tractors are not considered within this standard.

DEFINITION

The purpose of the Standard is to establish common mounting and clearance dimensions for hydraulic remote-control cylinders and trailing-type farm implements with such other specifications as are necessary to accomplish the following objectives:

(a) To permit use of any make or model of trailing-type farm implement adapted for control by an 8-in-stroke hydraulic cylinder, with the 8-in-stroke hydraulic cylinder furnished with any make or model of farm tractor.

(b) To permit use of any make or model of trailing-type farm implement adapted for control by a 16-in-stroke hydraulic cylinder, with the 16-in-stroke hydraulic cylinder furnished with any make or model of farm tractor, consistent with the maximum drawbar pull of the tractor normally required to operate the implement.

(c) To facilitate changing the hydraulic cylinder from one implement to another and decrease the possibility of introducing dirt or other foreign material into the hydraulic system, by reducing the necessity for supplemental hose lengths or piping with certain types of implements.

STANDARD DIMENSIONS AND SPECIFICATIONS

for

Hydraulic Remote Controls Including a Cylinder with 8-in Working Stroke

1 The hydraulic cylinder with hose shall be considered as part of the tractor hydraulic remote control and shall be built to standard dimensions.

2 Both single and double-acting cylinders shall operate to raise the implements (or deangle disk harrows) on their extending stroke. Implements requiring actuating force in both directions should be operated by a double-acting cylinder.

3 Provision shall be made on the implement to accommodate the full stroke of the hydraulic cylinder. Variable-stroke control necessary in the application of hydraulic control to some implements shall be incorporated in the cylinder or hydraulic system and applied on the retracting stroke.

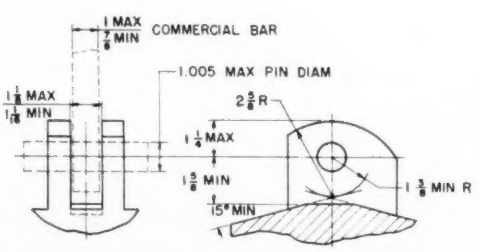


Fig. 1 Yoke clearances (anchor end) for 8-in-stroke hydraulic cylinder

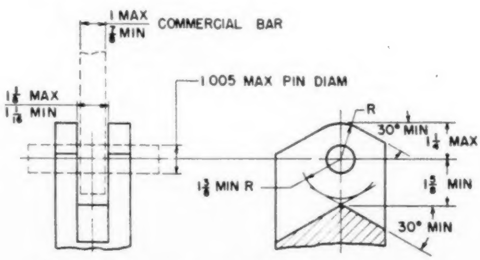


Fig. 2 Yoke clearances (rod end) for 8-in-stroke hydraulic cylinder

4 *Cylinder Length of Stroke.* 8-in — plus 1/8 in
— minus 0 in

5 *Distance, Center to Center Between Attaching Pins.*

Extended, 28-1/4 in — plus 1/8 in
— minus 0 in

6 *Size of Attaching Pins.* Cylinder attaching pins shall be of 1 in nominal diameter. Oversize tolerance, 0.005 in maximum. Implement mountings shall provide operating clearance for 1.005-in maximum diameter pins.

7 *Type of Ends.* Yoke on anchor and rod ends.

8 *Width of Throat.* 1-1/16 in minimum and 1-1/8 in maximum for bar 7/8-in minimum and 1-in maximum thickness.

9 *Depth of Throat.* The anchor end of the cylinder shall provide the clearance shown in Fig. 1. This affords clearance for a 1 x 2-1/2-in bar through a 30-deg included angle, equally divided, and a 1 x 3-in bar in a perpendicular position.

The rod end of the cylinder shall provide the clearance shown in Fig. 2. This affords clearance for a 1 x 2-1/2-in bar through a 60-deg included angle, equally divided, and a 1 x 3-in bar in a perpendicular position.

10 *Clearance Area on Implements.* Hydraulic cylinders shall operate within the composite volume specified in Fig. 3A and Fig. 3B. Implements designed for remote-cylinder operation shall provide clearance for a cylinder of the composite volume specified in Fig. 3A and Fig. 3B.

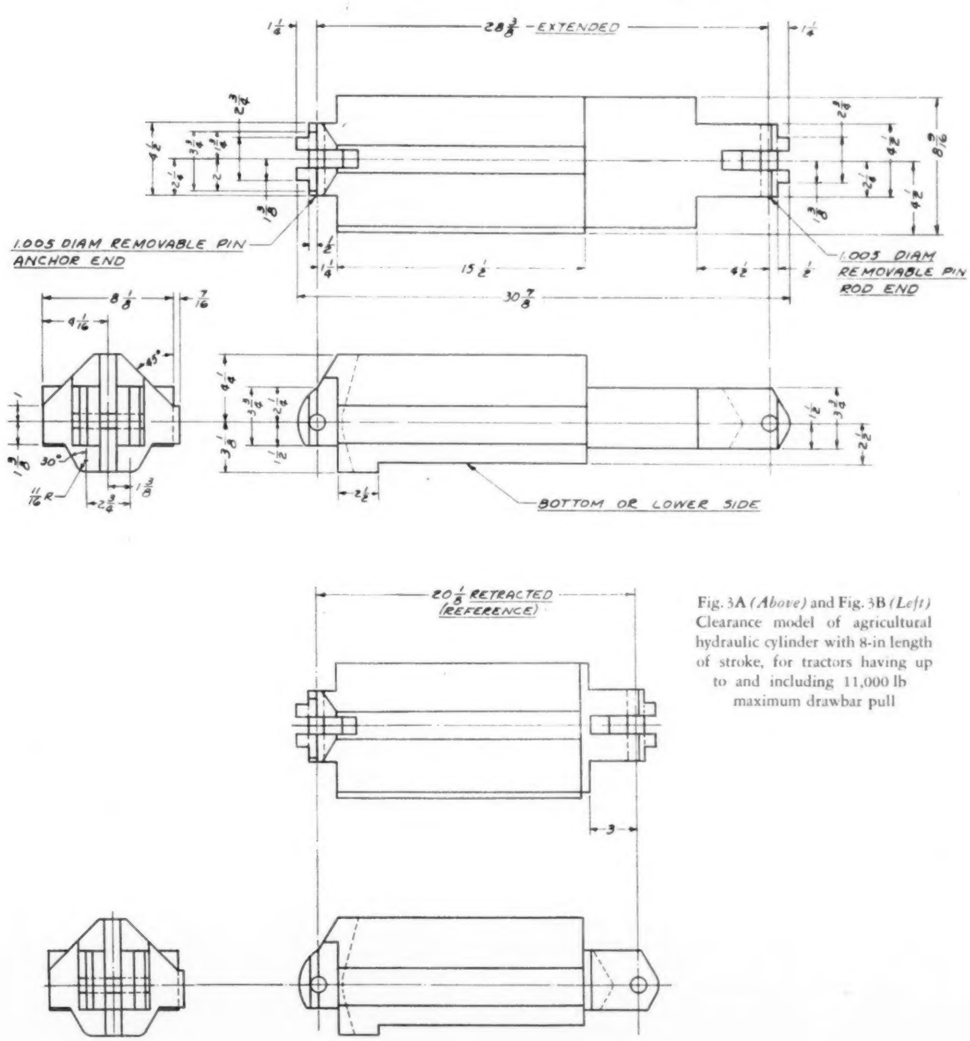


Fig. 3A *(Above)* and Fig. 3B *(Left)* Clearance model of agricultural hydraulic cylinder with 8-in length of stroke, for tractors having up to and including 11,000 lb maximum drawbar pull

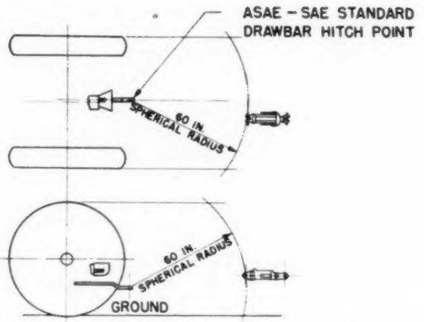


Fig. 4 Hose length diagram for wheel-type tractor drawbar — 60-in spherical radius (A.S.A.E.–S.A.E. Standard)

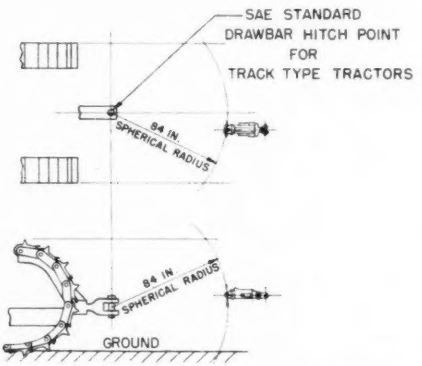


Fig. 6 Hose length diagram for track-type tractor drawbar — 84-in spherical radius (S.A.E. Standard)

11 *Standard Hose Lengths for Remote Hydraulic Cylinders.* The tractor manufacturer shall provide sufficient lengths of hose so that the hydraulic cylinder, provided with tractors having a work capacity up to 6,000 lb maximum drawbar pull, is operable when the front anchor pin is located at a maximum 60-in spherical radius from a center which is the A.S.A.E.-S.A.E. Standard Drawbar Hitch Point (Fig. 4).

Tractors with a work capacity between 6,000 and 11,000 lb maximum drawbar pull shall be provided by the manufacturer with sufficient lengths of hose so that the hydraulic cylinder is operable when the front anchor pin is located at a maximum 84-in spherical radius from the drawbar hitch point.

On such tractors, for which the A.S.A.E.-S.A.E. Standard Power Take-Off Shaft is available, the A.S.A.E.–S.A.E. Standard Drawbar Hitch Point shall be used, as shown in Fig. 5. On all other track-type tractors, the S.A.E. Standard Track-Type Drawbar Hitch Point shall apply as shown in Fig. 6.

The implement manufacturer shall locate the hydraulic cylinder on the implement to provide allowance for cushion spring hitches, maneuverability and turning so that the implement can be operated safely without stretching or breaking the hose under any circumstances.

12 *Hose Supports.* Support required for remote cylinder hose shall be considered as part of the implement.

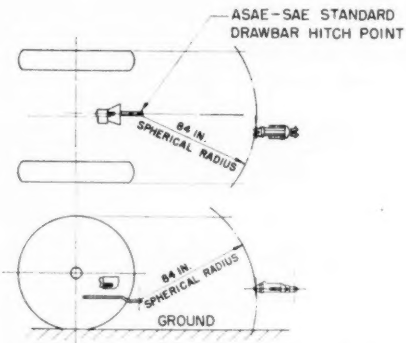


Fig. 5 Hose length diagram for wheel-type tractor drawbar — 84-in spherical radius (A.S.A.E.–S.A.E. Standard)

13 *Hose Connections to Cylinders.* Hose connections shall be such that the hose will not interfere with bars extending through the yoke on either end of the hydraulic cylinder.

14 *Operating Time at Rated Engine Speed.* 1-1/2 to 2 sec per 8-in stroke at rated hydraulic pressure.

* * * *

RECOMMENDED PRACTICE: SUPPLEMENTAL HOSE LENGTHS

(Not a part of the Standard)

As built at present, the position of the hydraulic cylinder on some large disk implements requires additional hose beyond that necessary for the specified spherical radius from center of drawbar hitch point. For implements requiring additional hose length, two supplemental hose lengths increasing the spherical radius by 60-in and 96-in increments shall be made available by the tractor manufacturer on special orders. When supplemental hose lengths are used, self-sealing couplings shall be provided for each of the hose lines leading from the tractor and for the supplemental hose lengths.

STANDARD DIMENSIONS AND SPECIFICATIONS *for* *Hydraulic Remote Controls Including a Cylinder with 16-in Working Stroke*

1 The hydraulic cylinder with hose shall be considered as part of the tractor hydraulic remote control and shall be built to standard dimensions.

2 All hydraulic cylinders shall be double acting and shall operate to raise the implements (or deangle disk harrows) on their extending stroke.

3 Provision shall be made on the implement to accommodate the full stroke of the hydraulic cylinder. Variable-stroke control necessary in the application of hydraulic control to some implements shall be incorporated in the cylinder or hydraulic system and applied on the retracting stroke.

4 *Cylinder Length of Stroke.* 16 in — plus 1/8 in
— minus 0 in

5 *Distance, Center to Center Between Attaching Pins.*
Extended, 47-1/2 in — plus 1/8 in
— minus 0 in

6 *Size of Attaching Pins.* Cylinder attaching pins shall be of 1-1/4 in nominal diameter. Oversize tolerance, 0.005 in maximum. Implement mountings shall provide operating clearance for 1.255-in maximum diameter pins.

7 *Type of Ends.* Yoke on anchor and rod ends.

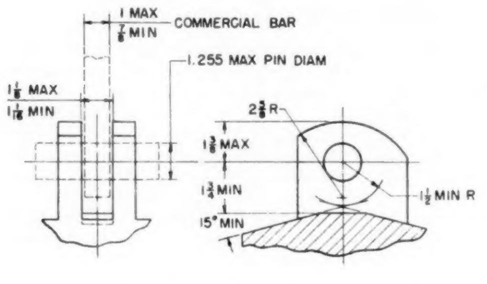


Fig. 7 Yoke clearances (anchor end) for 16-in-stroke hydraulic cylinder

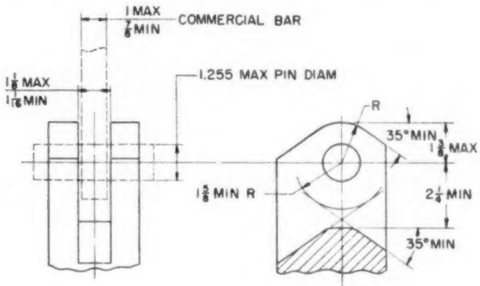
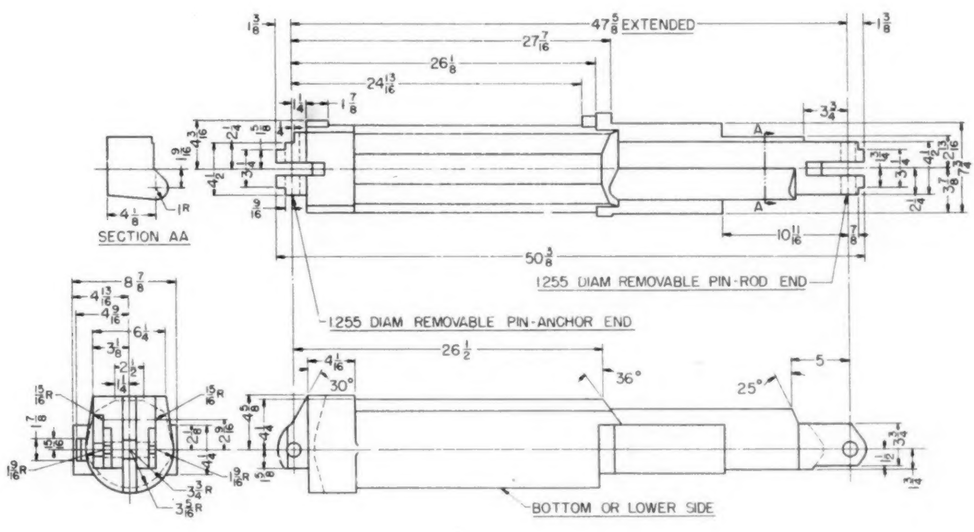


Fig. 8 Yoke clearances (rod end) for 16-in-stroke hydraulic cylinder



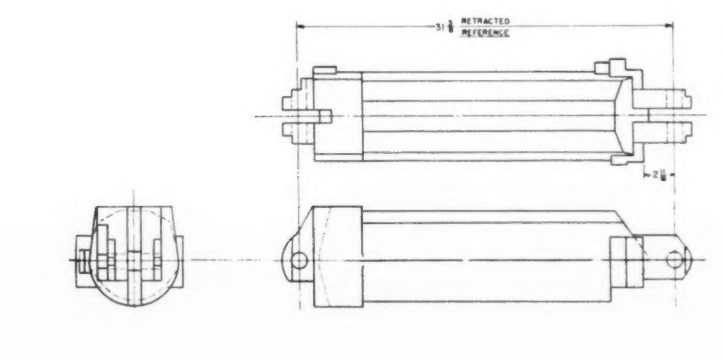


Fig. 9A *(Above)* and Fig. 9B *(Left)* Clearance model of agricultural hydraulic cylinder with 16-in length of stroke for tractors having up to and including 11,000 lb maximum drawbar pull

8 *Width of Throat.* 1-1/16 in minimum and 1-1/8 in maximum for bar 7/8-in minimum and 1-in maximum thickness.

9 *Depth of Throat.* The anchor end of the cylinder shall provide the clearance as shown in Fig. 7. This affords clearance for a 1 x 2-3/4-in bar through a 30-deg included angle, equally divided, and a 1 x 3-1/4-in bar in a perpendicular position.

The rod end of the cylinder shall provide the clearance as shown in Fig. 8. This affords clearance for a 1 x 3-in bar through a 70-deg included angle, equally divided, and a 1 x 4-in bar in a perpendicular position.

10 *Clearance Area on Implements.* Hydraulic cylinders for tractors, up to and including those with a working capacity of 11,000 lb maximum drawbar pull, shall operate within the composite volume specified in Fig. 9A and Fig. 9B. Hydraulic cylinders for larger tractors, up to and including those with a work capacity of 20,000 lb maximum drawbar pull, shall operate within the composite volume specified in Fig. 9C and Fig. 9D. Implements designed for remote-cylinder operation shall provide clearance for a cylinder of the composite volume specified in Figs. 9A and 9B or Figs. 9C and 9D consistent with maximum drawbar pull of the tractor normally required to operate the implement.

11 *Hose Lengths for Remote Hydraulic Cylinders.* The tractor manufacturer shall provide sufficient hose, including a self-sealing coupling in each line, so that the hydraulic cylinder is operable when the front anchor pin is located at a maximum 96-in spherical radius from the drawbar hitch point. On tractors for which the A.S.A.E.-S.A.E. Standard Power Take-off Shaft is available, the A.S.A.E.-S.A.E. Standard Drawbar Hitch Point shall be used as shown in Fig. 10. On all other track-type tractors, the S.A.E. Standard Track-Type Drawbar Hitch Point will apply as shown in Fig. 11.

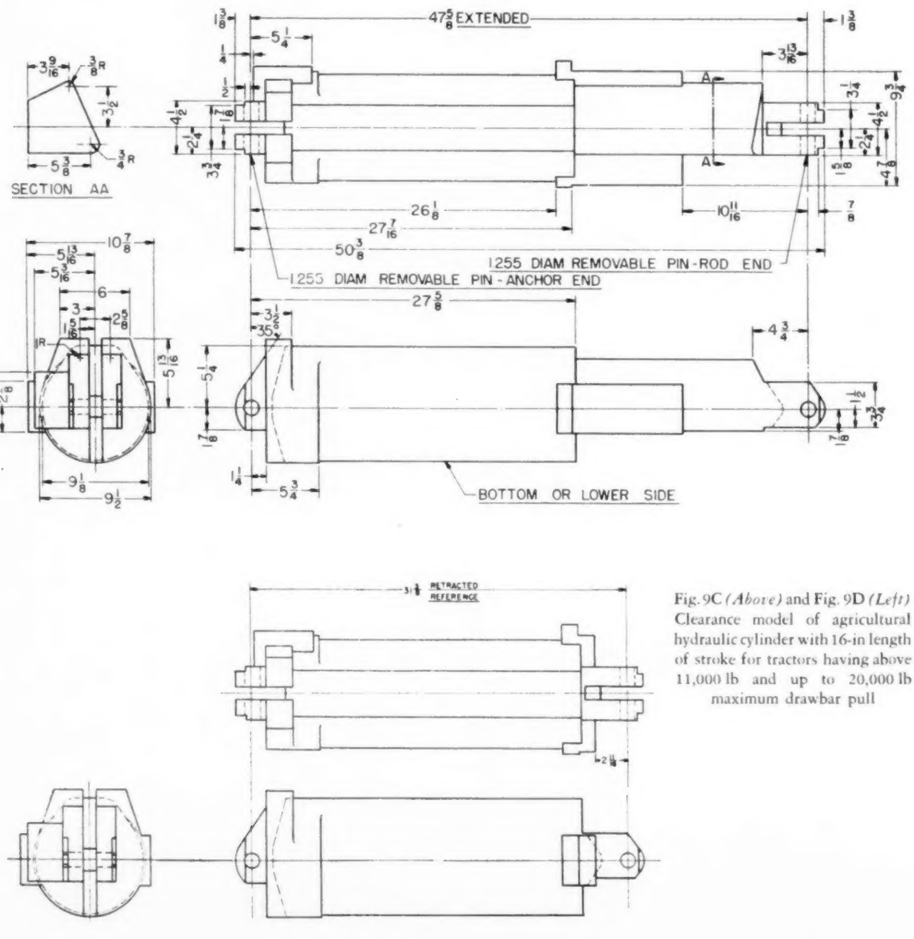


Fig. 9C *(Above)* and Fig. 9D *(Left)* Clearance model of agricultural hydraulic cylinder with 16-in length of stroke for tractors having above 11,000 lb and up to 20,000 lb maximum drawbar pull

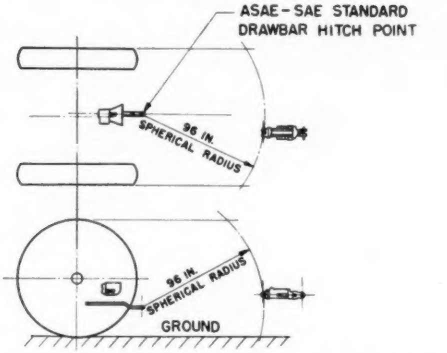


Fig. 10 Hose length diagram for wheel-type tractor drawbar—96-in spherical radius (A.S.A.E.–S.A.E. Standard)

To provide for the hydraulic control of implements on which the cylinder is positioned outside of the specified 96-in spherical radius, two lengths of supplemental hose, each including a self-sealing coupling and increasing the spherical radius by 60-in and 96-in increments shall be made available by the tractor manufacturer.

The implement manufacturer shall locate the hydraulic cylinder on the implement to provide allowance for cushion spring hitches, maneuverability, and turning so that the implement can be operated safely without stretching or breaking the hose under any circumstances.

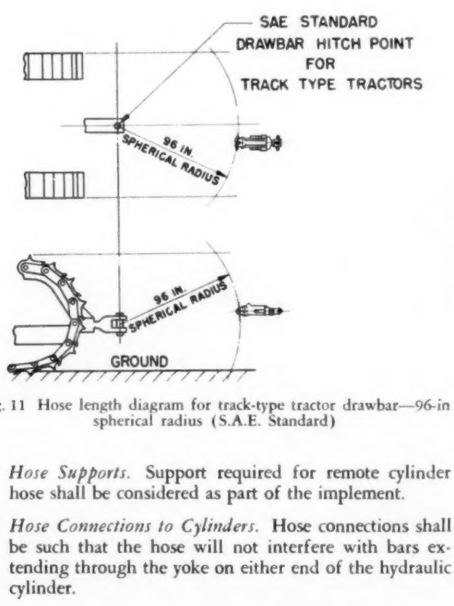


Fig. 11 Hose length diagram for track-type tractor drawbar—96-in spherical radius (S.A.E. Standard)

12 *Hose Supports.* Support required for remote cylinder hose shall be considered as part of the implement.

13 *Hose Connections to Cylinders.* Hose connections shall be such that the hose will not interfere with bars extending through the yoke on either end of the hydraulic cylinder.

14 *Operating Time at Rated Engine Speed.* 3 to 5 sec per 16-in stroke at rated hydraulic pressure.

NEW BULLETINS

The Cleaning of Mechanically Harvested Cotton, by H. P. Smith, D. L. Jones, and H. F. Miller, Jr., Texas Agricultural Experiment Station (College Station) Bulletin 720 (March 1950). Deals with problems of cleaning machine-stripped and machine-picked cotton in Texas as influenced by variety, time of harvest, machine combinations and modifications, and other factors.

A Handbook of Peanut Growing in the Southwest. Bulletin 727, Texas Agricultural Experiment Station (College Station) and Bulletin B-361, Oklahoma Agricultural Experiment Station (Stillwater) (November 1950). This bulletin is the result of cooperation between several subject matter departments in the two stations indicated. It covers recommended procedures from selection of the soil to utilization of by-products.

Irrigating the Prairie Home Garden, by H. C. Korven, Department of Agriculture (Ottawa, Canada) Publication 851 (December 1950) Gardening and related practices for irrigation by surface methods and by sprinkling.

Vitamin B_{12} A P F Concentrates and Antibiotics in Poultry Rations, by J. R. Couch and J. R. Reed. Progress Report 1251 (1950), Texas Agricultural Experiment Station (College Station). A two-page leaflet reporting favorable response to feeding tests in a new nutritional field due for much further scientific study.

Storage of Cotton Seed for Planting Purposes, by H. F. Miller and L. E. Ellwood. Progress Report 1262 (1950) Texas Agricultural Experiment Station (College Station). Preliminary results indicate desirability of selecting for seed freshly ginned cotton seed low in field damage, moisture (under 12 per cent) and free fatty acid. Drying and cooling facilities may make it possible to bring higher moisture content seed down to a safe figure before viability is impaired.

A Tractor-Mounted Spray for Cotton Defoliation, by M. F. Bloodworth, C. A. Burleson, and W. R. Cowley. Progress Report 1284 (1950), Texas Agricultural Experiment Station (College Station). An experimental unit indicated good possibilities from the standpoint of performance, cost, and adaptability to further use in spraying for pest control.

The Yield and Quality of Cabbage as Affected by Different Levels of Fertility and Irrigation, by C. A. Burleson, M. F. Bloodworth, J. S. Morris, P. W. Leeper, and W. R. Cowley. Progress Report 1289 (1950), Texas Agricultural Experiment Station (College Station). Nitrogen fertilizers and generally high moisture levels improved production as to both yield and quality. Time and amount of water application are indicated as critical factors warranting further study.

Size of Spray Nozzle in Relation to Cotton Insect Control, by H. F. Miller and J. C. Gaines. Progress Report 1312 (January 1951), Texas Agricultural Experiment Station (College Station). Indicates promising results in the direction of low-gallonage economy.

Drying Brown Corn in Texas, by J. W. Sorenson and M. G. Davenport. Progress Report 1350 (April 1951), Texas Agricultural Experiment Station (College Station). Based on tests in 3 years, drying in layers not more than 6 in deep with a minimum of 65 c f m of air per square foot of floor area, and maximum temperature of 150 F, is recommended.

Drying and Storing Flax Seed in South Texas, by M. G. Davenport, R. A. Hall, and J. W. Sorenson. Progress Report 1352 (April 1951), Texas Agricultural Experiment Station (College Station). Based on one year's tests with a column type drier the authors tentatively recommended seed columns 10 in thick, 80 f p m minimum velocity of air through the seed, drying air temperatures of 150 F for seed with 9 to 11 per cent moisture and 175 F for seed with 15 to 18 per cent moisture, cooling of seed before storing, drying to 6 to 7 per cent moisture for safe storage in bins, forced aeration of bulk storage in metal bins, thorough ventilation of seed stored in sacks, and frequent checks on summer temperatures of seed in storage.

Mechanical Harvesting of Cotton in Texas, by H. F. Miller, H. P. Smith, D. L. Jones, J. R. Johnston, D. I. Dudley, and E. B. Hudspeth. Progress Report 1337 (March 1951) Texas Agricultural Experiment Station (College Station). Summarizes studies leading to definite sets of recommendations on culture and operations for stripping and picking.

Electricity in Crop Conditioning. Electro-Agriculture Section, Technical Standards Division, Rural Electrification Administration, (Washington, D.C.) (March 1951). Summarizes current recommendations as to moisture, air, heat, and structure requirements; operating instructions; feeding and grading evaluations; and references on the conditioning of various common crops in the several areas in which they are grown commercially.

NEWS SECTION

Denniston to Head Iowa-Illinois Section

AT THE second annual meeting of the Iowa-Illinois Section of the American Society of Agricultural Engineers held at the Short Hills Country Club, East Moline, Ill., May 5th, W. L. Denniston, experimental design engineer, John Deere Harvester Works, Deere and Co., was elected chairman of the Section for the ensuing year. It was Mr. Denniston, together with R. H. Maier and D. O. H. Miller, who originally promoted the idea for the formation of this Section. Mr. Denniston succeeds Robert R. Roth, design engineer, Minneapolis-Moline Co.

Other officers elected at the meeting included two vice-chairmen, C. K. Beeman, engineering dept., J. I. Case Co., at Burlington, Iowa, and H. V. Hansen, one of the partners of Hansen Brothers Agricultural Engineering Sales and Service at Hillsdale, Ill. C. R. Recor, district engineer for The Torrington Co., was elected secretary-treasurer. The new Nominating Committee of the Section includes W. E. Knapp (chairman), J. L. Marsh, and R. M. Merrill.

A total of 74 members and friends of the Society registered for the meeting. The program included two technical papers, one entitled "Practical Spring Design" by Francis Smiley, American Steel and Wire Div., U.S. Steel Corp., and the other entitled "The Use of LP Gas as a Tractor Fuel," by Roger R. Yoerger, instructor in agricultural engineering, Iowa State College. E. W. Hamilton, tractor div., Allis-Chalmers Mfg. Co., gave a stimulating address on the subject of grassland farming which is published elsewhere in this issue. Following the luncheon, Lester S. Kellog, economist, Deere and Co., gave a most interesting talk on special problems in a "quartering" war economy.

Program of Pennsylvania Section Spring Meeting

A TOTAL of fifty members and guests of the Pennsylvania Section of the American Society of Agricultural Engineers registered for the Section's spring meeting at Pennsylvania State College, April 6 and 7. A number of members of the ASAE Student Branch and other local persons were also in attendance.

An interesting program, over which Section Chairman Charles G. Burress presided, included the following topics: techniques of testing, agricultural engineering research at Pennsylvania State College, equipment for grassland farming, pasture renovation, design ducts for mow hay finishers, plastic pipe in agriculture, infrared brooding, engineering and soil conservation, benefits and costs of tile drainage and farm ponds, and testing for soil exclusion from tillage tool bearings.

Dr. Milton S. Eisenhower, president, Pennsylvania State College, was the principal speaker at the Section dinner attended by 140 persons including agricultural engineering students and alumni of the College. R. U. Blasingame, head of the agricultural engineering department, reviewed the work of the department since its organization, and William R. Bower, president, ASAE Student Branch, spoke on branch activities.

A.S.A.E. Meetings Calendar

June 18-20 — ANNUAL MEETING, Rice Hotel, Houston, Tex.

August 27-29—NORTH ATLANTIC SECTION, Chalfonte-Haddon Hall, Atlantic City, N. J.

December 17-19—WINTER MEETING, The Stevens, Chicago, Ill.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to A.S.A.E., St. Joseph, Michigan

Minnesota Section Holds Spring Meeting

THE Minnesota Section of the American Society of Agricultural Engineers held its annual spring meeting in the Twin Cities April 20, with a total registration of 80 members and guests, including ten out-of-state members from Iowa and three from Wisconsin.

One of the high lights of the program was a paper by Parker Sanders of Sanders Farms on agricultural engineering in farm management. W. R. Peterson, manager of the International Harvester experimental farm, described two labor-saving experiments they have in operation at the farm, namely, a tractor-mounted sprinkler irrigation system and a self-feeding trench silo. Leonard Nelson, of Hitchcock and Estabrook, discussed the use of cannery waste as a fertilizer. The Northern States Power Co. exhibited an operating model of a dairy farmstead complete with a mechanical barn-cleaning and feed-handling equipment which attracted considerable interest. Following the program an inspection tour was made of the combine plant of Minneapolis-Moline Co.

At the Section dinner held in the evening, Dr. W. H. Kliever, director of research, Minneapolis-Honeywell Regulator Co., gave an interesting and stimulating discussion of control devices and their possible application in agriculture. Minnesota Section Chairman Marvin J. Samuelson presided at the dinner.

BFBA Elects Eakin as President

AT ITS annual meeting on April 26 held in New York City, the Better Farm Buildings Association elected W. Everett Eakin, farm research director, Libbey-Owens-Ford Glass Co., as president of the Association for the ensuing year. He succeeds J. F. Schaffhausen, manager, farm markets, Johns-Manville Corp., who becomes chairman of the board of the Association, which is a nation-wide group working to coordinate planning and research for farm buildings.

Other officers elected at the meeting include O. A. Hanke, editorial director, *Poultry Tribune*, as vice-president; M. V. Engelbach, manager of field engineering, The Ruberoid Co., as secretary, and James L. Strahan, technical director, Asphalt Roofing Industry Bureau, as treasurer.

The above-named officers of BFBA are *(Continued on page 336)*

This picture shows part of the group attending the ASAE Pennsylvania Section dinner on April 7. Seated (left to right) at the head table are Dr. F. F. Lininger director, Pennsylvania Agricultural Experiment Station; Dr. R. B. Dickerson, director, resident instruction, school of agriculture; Dr. L. E. Jackson, dean of agriculture; L. S. Singley, West Penn Power Co., and master of ceremonies; Dr. Milton S. Eisenhower, president; C. G. Burress, Section chairman; W. R. Bower, president, ASAE Student Branch; A. O. Morse, college provost; R. U. Blasingame, and F. D. Miller

NEWS SECTION

(Continued from page 334)

all members of the American Society of Agricultural Engineers, and the Society is one of the member organizations of the Association.

Kenney New Chairman Georgia Section

W. D. KENNEY, agricultural engineer, University of Georgia and USDA, stationed at Tifton, was elected chairman of the Georgia Section of the American Society of Agricultural Engineers at its spring meeting, May 4 and 5, at Panama City, Fla. He succeeds J. Irwin Davis, Sr. John T. Phillips, Jr., vice-president, Lilliston Implement Co., Albany, was elected the new vice-chairman of the Section, and James M. Stanley, agricultural engineer, University of Georgia and USDA, also of Tifton, was elected secretary.

Twenty-seven members and friends of ASAE attended the meeting. A technical program on May 4 featured the following subjects and speakers: The tractor tire testing program at the USDA Tillage Machinery Laboratory, Auburn, Ala., by I. F. Reed, USDA; grain storage and processing equipment in the Southeast, by W. M. Bruce, USDA agricultural engineer, stationed at Athens, and agricultural engineering as a general education, by Dr. E. G. McKibben, principle agricultural engineer, USDA, stationed at Auburn, Ala.

The main feature of the meeting, which is usually a deep sea fishing expedition on the Gulf of Mexico, was held on May 4, the success of which failed to come up to anticipations due to conditions unfavorable to comfort and fishing.

Alabama Section Elects Penn

M. B. PENN, agricultural engineer, Alabama Power Co., was elected chairman of the Alabama Section of the American Society of Agricultural Engineers at its meeting at Gulf Shores, Ala., May 11 and 12. He succeeds J. B. Wilson. C. A. Rollo, manager, Grimes Tractor and Implement Co., Montgomery, was elected the new vice-chairman of the Section, and J. L. Butt, associate agricultural engineer, Alabama Polytechnic Institute, was re-elected secretary.

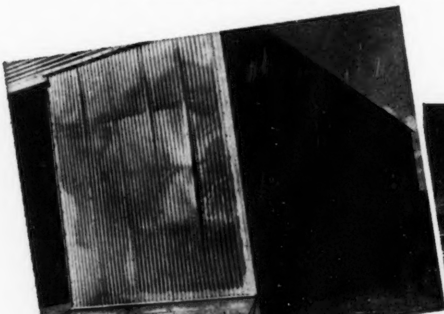
Fifty-nine members and friends of ASAE attended the meeting, the first day of which was devoted to a program opened by John T. Phillips, Jr., Lilliston Implement Co., Albany, Ga., with a vivid description of peanut farming in Africa. The second speaker, R. Y. Bailey, regional research representative, U.S. Soil Conservation Service, at Spartanburg, S.C., described problems encountered in soil and water conservation and procedures used to correct them. K. M. Hickman, manager of agricultural sales, Link-Belt Co, presented an interesting paper on the chain drives. The use of steel in farm buildings and fences, with special emphasis on proper installation, was discussed by Harry Dearing, agricultural engineer, Tennessee Coal, Iron and Railroad Co. W. T. Kramer, Link-Belt Co., described the various applications of screw conveyors in farming operations. A motion picture on development work on cotton pickers was presented by R. C. Fergason, chief engineer, Allis-Chalmers Mfg. Co., Gadsden, Ala., Works. The concluding paper by C. D. Weldon, Alabama Power Co., described the use of heating cables and infrared in brooding poultry.

At the Section dinner on May 12, Judge R. B. Carr of the Court of Appeals, Montgomery, made an inspirational address on Americanism. On the second day of the meeting the group *(Continued on page 340)*

Steel barn

after 3,000

"All night long and into the next day the barn glowed a cherry red," says Mr. Russell. Here, he pokes around in the hot ashes, all that was left of the 3,000 bales of hay.



"I was mighty lucky to have had my hay in this steel barn because none of the other farm buildings were threatened," says Mr. Russell. "The fire never got out of the steel barn in spite of the wind." Here are pictures of the building taken after the fire.

Although the hay was piled nearly to the roof the fire damage to the building was quite limited. Notice that despite the night-long fire most of the roofing and siding sheets are still serviceable and could have been reset and tightened. The frame was not badly damaged and after the replacement of a few bracing members the frame was adjudged sound and durable.

still in service
bales of hay burn to ashes

Here's the true story as told by Elvin Russell, Apple River, Ill.

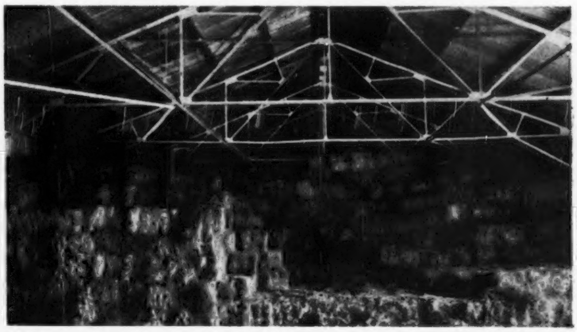
"EVER since we had a terrible fire at our farm in Wisconsin in 1924, I've wanted to put up fireproof buildings. But if the man who sold me this steel barn in 1949, had told me that it would still be standing after 3,000 bales of hay had burned to ashes inside its walls, I would not have believed him.

"Although the loss of my best hay was hard to take, I still think I was mighty lucky to have had it in this steel barn, because none of the other farm buildings were threatened. The fire never got outside the steel barn in spite of the wind."

Farmers still talk about the 1949 fire at Russell's Wisconsin farm. It started at 5:00 P. M. All night long and into the next day the barn glowed a cherry red. The fire was extra bad because the bales were not stowed tightly—plenty of air could circulate. Almost any other type of construction would have allowed the roaring flames to spread. The entire farmstead might have been destroyed . . . but the fire never once got outside the tough steel building.

How's the building now? Well, for the sake of appearance Mr. Russell replaced some of the steel sheets that had warped. A few of the bracing members were also replaced. The building is now in service, and it will *stay* in service for many years to come. Proof again that *you get more for your money when you build with steel.*

Here is the building today. The old sheets were serviceable. But since the heat discolored them, some were replaced to improve the appearance. Ventilators are a later addition to remove excess moisture.



Today, nearly two years after the fire, farmers still come from miles around to see this steel barn for themselves. It is in A-1 condition. Notice that Mr. Russell still uses his steel barn for hay storage because he has complete faith in the fire protection of steel.

AMERICAN STEEL & WIRE COMPANY, CLEVELAND
COLUMBIA STEEL COMPANY, SAN FRANCISCO
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM
UNITED STATES STEEL COMPANY, PITTSBURGH
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

U·S·S GALVANIZED STEEL for ROOFING and SIDING

SEND THE COUPON FOR FURTHER INFORMATION

Agricultural Extension Section
United States Steel Company, Room 4262,
525 William Penn Place, Pittsburgh 30, Pa.

Please send me free literature about steel farm buildings. Building will be used for ....

Approximate size or capacity ....

Send information to:

Name ....

Address ....

County .... State ....

United States Steel Company is a steel producer, not a steel fabricator. Your request, therefore, will be sent to building manufacturers who fabricate steel buildings for farm use.

UNITED STATES STEEL

NEWS SECTION (Continued from page 336)

invaded the Gulf of Mexico and nearby lakes and succeeded in landing over 150 pounds of ling and 100 pounds of small fish. Ace fishermen were Stoddard, McKibben, Pettus, Hickman, and the meat hook.

Chris Nyberg New Chairman of Michigan Section

MICHIGAN and Ohio members of the American Society of Agricultural Engineers and guests gathered in Toledo, May 5, for the spring meeting of the Michigan Section.

Robert E. Johnson, manager, farm power department Toledo Edison Co., headed the host group of Toledo members and served as presiding chairman for the meeting.

Through the courtesy of the Toledo Edison Co., the Section met at the Edison Club on the Maumee River near Toledo. The meeting place proved of special interest in that the clubhouse was developed by the remodeling of an absolete hydroelectric power plant.

Chris Nyberg, chief engineer, Battle Creek Works, The Oliver Corp., was elected chairman of the Section for the ensuing year. Others elected were Jack R. Schram, Ernest H. Kidder, and Nolan Mitchell, vice-chairmen; and Robert G. White, secretary. A. W. Farrall, J. C. Cahill, and D. B. Poor are the nominating committee for the next election in 1952.

Guests from other sections who were present included Harold H. Beaty, rural service manager, Edison Electric Institute, and Frank P. Hanson, agricultural engineer, Caterpillar Tractor Co. Mr. Beaty was introduced and spoke briefly at the opening of the meeting, on the organization and work of the farm section of Edison Electric Institute. Mr. Hanson responded at the luncheon with brief remarks on the interest of the Society in activities related to national defense.

I. P. Blauser, extension agricultural engineer, Ohio State University, was the opening speaker on the formal program. In discussing the Ohio Farm Electrification Council, its organization and program, he indicated that it is the result of a long-continued effort to improve the mechanics of cooperation between the various agencies interested in the further progress of rural electrification in Ohio.

New methods for handling onions, as discussed by J. S. Boyd, assistant professor of agricultural engineering, Michigan State College, are steps toward increased bulk handling to reduce labor requirements and storage problems.

A new research approach to pest control problems by the electrostatic precipitation of agricultural dusts was reported by the graduate team of H. D. Bowen and Peter Hebblethwaite, Michigan State College. Their work, still in its early stages, is on the charging of pesticide dusts to establish an attraction between the dust particles and grounded plant parts. This method was indicated to offer promise of improved coverage with finer dust particles, reduced waste of material, and simplified application. Field tests are scheduled to be made this summer.

Reclamation and the sportsman, as discussed by W. A. Cutler, extension agricultural engineer, Michigan State College, do not necessarily represent conflicting interests. He granted that some mistakes have been made in drainage and other reclamation projects, but pointed to other instances in which such projects have benefited wild life and related recreational facilities.

A recently completed agricultural extension film entitled "Harvesting and Drying Corn," was shown by D. B. Poor, agricultural engineer, Stran-Steel Division, Great Lakes Steel Corp. This completed the meeting program.

Chicago Section Looks Ahead

CHALLENGES to agricultural engineers to help the farmers of tomorrow were presented to the Chicago Section of the American Society of Agricultural Engineers at its spring meeting May 7, at the Builders' Club.

Dr. Lowell S. Hardin, agricultural economics department, Purdue University, emphasized these challenges in the principal address of the meeting, titled "This Business of Farming — Yesterday, Today, and Tomorrow."

Speaking as an economist, he pictured opportunities for the further development and application of agricultural engineering to help farmers improve their operating economy in utilizing chemicals, land use practices, further mechanization, specialized production and custom operations, farm size changes, and operating organization and methods for labor economy.

Most of the other speakers were members of the Section. W. R. Peterson explained some of the specific problems encountered in further mechanization of farm chores. L. G. Samsel urged added attention to developing the fullest use possibilities of established common items on farm equipment such as the plow. D. G. Womeldorff spoke for complete unit equipment, including matched and attached motive power in appropriate cases.

Another guest of the Section, Charles Walte, Jr., Reynolds Metals Co., indicated further opportunity for engineering to provide farmers with suitable, complete-unit structures.

C. N. Hinkle proved himself an able entertainer in the field popularized by Houdini, Thurston, and Blackstone.

The Section has scheduled its next meeting to be held early in October at the University of Illinois.

PERSONALS OF ASAE MEMBERS

Russell (W. J. R.) Brouder, after serving 14 years as an extension agricultural engineer in Alabama, Tennessee, and Arkansas, recently decided to engage in business for himself, and organized the Russell Farm Engineering Service which operates in the states of Arkansas and Louisiana. The attention of the business is principally to problems in irrigation and drainage, poultry equipment, and grain, rice and hay drying, more particularly in the rural electrification aspects.

James E. Garton, assistant agricultural engineer, Oklahoma Agricultural Experiment Station, has worked out "A Graphic Solution of Agricultural Field Sprayer Problems," recently issued in leaflet form by the Station as miscellaneous publication MP-19.

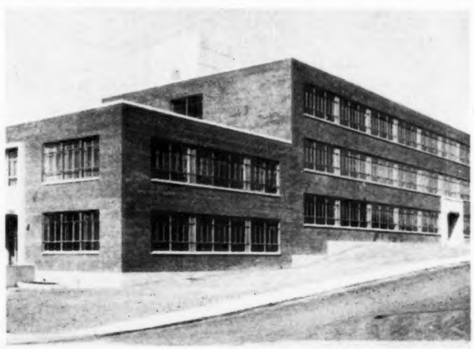
H. C. Korven, agricultural engineer in irrigation, Dominion Experiment Station, Swift Current, Sask., is author of "Irrigating the Prairie Home Garden," issued as Publication 851 of the Department of Agriculture, Ottawa, Canada.

Herbert F. Miller, Jr., assistant professor of agricultural engineering, Texas Agricultural Experiment Station, is senior author of three recently published progress reports. They are "Storage of Cotton Seed for Planting Purposes" (1262), "Size of Spray Nozzle in Relation to Cotton Insect Control" (1312), and "Mechanical Harvesting of Cotton in Texas" (1337). Joint authors of the latter report also include *H. P. Smith*, professor of agricultural engineering, A. & M. College of Texas, and *E. B. Hudspeth*, agricultural engineer, U.S. Department of Agriculture. Smith and Miller are also two of the authors of Station Bulletin 720, "The Cleaning of Mechanically Harvested Cotton."

J. W. Sorenson, associate professor of agricultural engineering, A. & M. College of Texas, and *M. G. Davenport*, assistant agricultural engineer, Substation No. 1, Beeville, Texas, are joint authors of recent progress reports on "Drying Broom Corn in Texas," (1350) and "Drying and Storing Flax in South Texas" (1352). Mr. Sorenson was also a contributor to "A Handbook of Peanut Growing in the Southwest," published jointly by the Texas and Oklahoma Agricultural Experiment Stations.

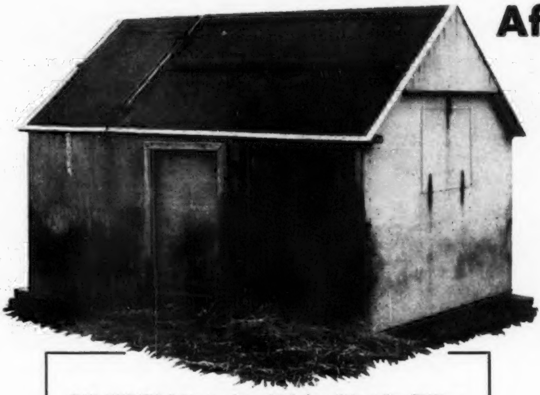
Necrology

PAUL J. NEWTON, chairman of the board, Keystone Manufacturing Co., Lewistown, Pa., passed away March 10 at his home in Belleville. He was 44 years of age. Following training in electrical engineering at Cornell University and early industrial experience, he entered the farm equipment field in 1937 as a sales engineer for the James Mfg. Co. In 1940 he joined the Austin-Western Co. as district sales manager, and continued in this work until 1942. During the latter nine months of that period he was loaned to the War Production Board, and served as chief of its construction machinery section. From 1942 to 1948 he served in the dual capacity of general manager and treasurer of the Hertzler and Zook Co., and consultant to the New Holland Machine Co. Since 1948 he had devoted his time to the development of a number of private interests in the farm equipment field. A member of ASAE since 1944, he had been active in the Pennsylvania Section and had helped it serve as host to the Annual Meeting of the Society at Philadelphia in 1947. He is survived by his wife Mary, at Belleville, and a daughter, Mary Ellen Shore of Albany, New York.



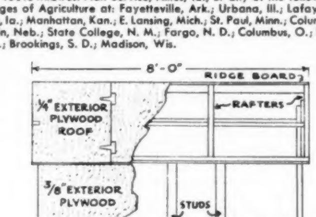
The building in this picture houses the five departments of engineering in the College of Engineering at the University of Idaho, including agricultural engineering. According to J. W. Martin, head of the latter department, the building will provide classroom and office space for all five departments of the college. The building is three stories high in front and five stories in the back, taking advantage of a natural hill for additional space

"This Exterior Plywood Hog House Is Still In Excellent Condition After 16 Years Service"

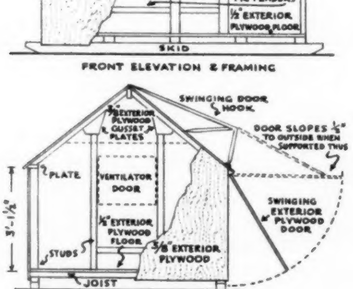


—Report Scientists at Veterinary Research Institute, Iowa State College, Ames, Ia.

PLAN AVAILABLE: Below are shown details from Midwest Plan 72631—a modernized version of the hog house described at right. For copy of plan send 45c to Midwest Plan Service, Ames, Ia., or any of the following State Colleges of Agriculture at: Fayetteville, Ark.; Urbana, Ill.; Lafayette, Ind.; Ames, Ia.; Manhattan, Kan.; E. Lansing, Mich.; St. Paul, Minn.; Columbia, Mo.; Lincoln, Neb.; State College, N. M.; Fargo, N. D.; Columbus, O.; Stillwater, Okla.; Brookings, S. D.; Madison, Wis.



FRONT ELEVATION & FRAMING



RIGHT END ELEVATION & FRAMING

Only Exterior-type Douglas fir plywood with 100% waterproof bond should be used for farm service structures. Positive identification is provided by the edge-branded grade-trademark EXT-DFPA® Douglas Fir Plywood Association (DFPA).

In August 1935, this movable Exterior plywood hog house was built to shelter animals being studied in connection with work on swine diseases by the Veterinary Research Institute, Iowa State College, Ames, Iowa.

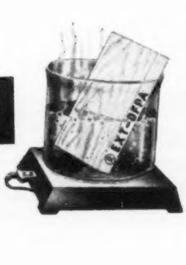
The structure has had continuous hard usage ever since. Because of the nature of the experiments (one of the major projects now being conducted is on swine brucellosis), sanitation is extremely important. In order to insure that no disease germs are carried over from one experiment to the next, the plywood hog house is periodically disinfected with steam and scalding water. Since disease studies require that the house often be moved to clean soil, the house is frequently hauled and jolted over rough terrain to new locations.

"Despite this rough treatment, the plywood hog house is still in excellent condition," report staff members at the animal research center. "The house shows no evidence of racking. The plywood has required absolutely no repairs and has stood the gaff of hard usage for 16 years. Its performance has been entirely satisfactory in every respect."

In addition to durability, Exterior plywood offers a number of distinct advantages for the construction of hog houses and other farm structures. Light, strong plywood builds easily-moved portable farm structures. The big, damage-proof panels afford tightness, rigidity and resistance to racking impossible with conventional materials. Large panel size stops drafts and air infiltration, speeds construction. Plywood is split-proof, puncture-proof . . . is easy to work with ordinary tools.

The Exterior plywood hog house which has proven so satisfactory at the Veterinary Research Institute is built according to plans developed by the Midwest Plan Service, a joint activity of the Land Grant Colleges in the North Central States and the U. S. Department of Agriculture.

Exterior-Type Douglas Fir Plywood



Can Be Boiled In Water—A Test Far More Severe Than Years of Weathering!

The 32-page booklet "Better Farm Buildings With Exterior Plywood" contains a section on plywood hog houses, as well as sections on silos, grain bins, dairy barns and other service buildings, on farm home construction and remodeling. For free copy, write (USA only): Douglas Fir Plywood Association, Tacoma 2, Washington. Field Offices: 848 Daily News Bldg., Chicago 6; 1232 Shoreham Bldg., Washington 5, D. C.; 500 Fifth Ave., New York City 18.

RESEARCH NOTES

A.S.A.E. members and friends are invited to supply, for publication under this heading, brief news notes and reports on research activities of special agricultural engineering interest, whether of federal or state agencies or of manufacturing and service organizations. This may include announcements of new projects, concise progress reports giving new and timely data, etc. Address: Editor, AGRICULTURAL ENGINEERING, St. Joseph, Mich.

USDA Agricultural Engineering Research

A CORRECTION

Attention is called to a typographical error in the USDA research notes in AGRICULTURAL ENGINEERING for May. Under the subtitle "Mechanization Aids Cotton Production" (page 284), it was stated: "Progress in cotton mechanization in the Southwest will aid production of 16 million bales, etc." The sentence should have read "*Southeast*", not Southwest.

• • •

Engineering Basic in Agricultural Progress. Arthur W. Turner, research director of the Divisions of Agricultural Engineering, U.S. Department of Agriculture, in a recent speech at the University of Georgia, credited agricultural progress as largely responsible for this country's present position of leadership in the world.

Speaking before a special chapel meeting commemorating the University's sesquicentennial, he said being able to produce food in volume is basic in establishing and maintaining a democratic civilized society such as we have in the United States.

"And, just as important," he pointed out, "is the ability to supply the facilities for volume food and fiber production. These facilities have been furnished by the agricultural engineers in such forms as efficient machines, processes, and structures — engineering facilities which have made our progress possible."

Turner pointed out to the students and faculty that today only 15.6 per cent of our entire population is on the farm producing more than enough food and fiber for all of us. Tremendous strides in mechanization, expansion of electric lines to farms, better farm structures, and time- and labor-saving methods allow these few people to supply the food and clothing needs of the rest of us. By comparison, he said, we often find as much as 85 per cent of the population of hunger-ridden countries scratching at the earth trying to get enough from it to feed and clothe themselves and the remaining 15 per cent.

The engineer has been an integral and important part in this country's rapid progress, and he holds the key to our continued world leadership through more efficient food and fiber production engineering, Turner said.

• • •

Curng Cigar Tobacco with Gas Offers Bigger Returns. Research in using gas heat to cure cigar-wrapper or shade-grown tobacco is providing a better quality product with less work and at less cost, report engineers of the U.S. Department of Agriculture. Curing studies using liquid petroleum (LP) gas in place of the conventional charcoal are being carried on in the two major cigar-tobacco producing areas of the United States with promising, although incomplete, results.

The USDA's Farm Electrification Division is cooperating in this work with the agricultural experiment stations at Storrs and New Haven in the Connecticut cigar tobacco region, and with the agricultural experiment stations at Athens and Tifton, Ga., in the southwest Georgia-northern Florida area. Experimentation has not yet gone far enough to permit the recommendation of gas curing of tobacco for farm use.

In one noteworthy experiment conducted in Connecticut last year, tobacco harvested from the same fields, at the same time and under the same conditions was placed in two similar barns located close together, one utilizing charcoal briquet fire, the other gas. The tobacco in the gas-fired barn averaged 43 cents more per pound in graded value than the charcoal-fired tobacco. Three cents of this difference resulted from the lower cost of gas as fuel. The remaining 40 cents was realized from a better price for higher quality tobacco, apparently the result of better curing with gas, say the engineers. Cigar wrapper tobacco brings a high price in comparison with other tobaccos, the Connecticut type averaging $2.15 a pound (farm price) in 1950.

The nearly 5,000 pounds of tobacco in the gas-fired barn would provide additional profit over charcoal firing of nearly $2,000 — almost twice the cost of installing gas firing equipment. From a strict cost of curing comparison, it costs $60 an acre to cure with gas; about $100 an acre to cure with charcoal briquets.

Engineers at both locations high-lighted the labor-saving advantages of gas firing. There is not only no charcoal to haul to keep the fires going when gas is used, but one man can also handle four or five curing barns if they are at the same location.

The research men used gas supplied to burners through flexible tubing. In this way, the burners could be moved from place to place on the barn curing floor to keep the curing uniform. The Georgia study showed that 30 gas burners, each supplying 20,000 Btu of heat per hour gave excellent curing results in a barn measuring 40 feet by 60 feet.

(*Continued on page 346*)

RESEARCH NOTES

(Continued from page 344)

Holman Accepts New Position with USDA. Leo E. Holman, U.S. Department of Agriculture engineer, has accepted a position as assistant to the head of the Division of Farm Buildings and Rural Housing, Beltsville, Md. Previously, Holman was associated with that Division conducting cooperative research at the University of Illinois. He replaces John W. Rockey, who recently became Administrative Assistant in charge of Business Operations of the Divisions of Agricultural Engineering.

• • •

Cooler Southern Homes Is Research Aim. Technical Bulletin 822, revised, "Factors Affecting Temperatures in Southern Farmhouses," is a new U.S. Department of Agriculture publication that reports an engineering research study of low-cost housing in the South. In addition to an analysis of research methods and results, this publication gives some ideas of simple and inexpensive ways to protect Southern homes from summer heat.

It suggests, for example, that many families may not appreciate how much the shade of trees on the house can cut daytime heat in the home. Shading walls with vines helped some, but shading the roof reduced the temperature of the air under the roof markedly.

The Southern family whose home has little protection from the sun and no mechanical cooling equipment will find summer living best either by having doors and windows closed and shaded by day and open by night, or by having doors and windows open day and night. Slat binds on the outside of doors and windows were of considerable help in keeping the closed house cool during the day. Another aid in reducing interior temperatures were ordinary roller shades covering all door and window glass. Such shades could reduce interior temperatures 6 degrees F provided little heat was given off by cooking in the closed house.

A water spray system, rigged to furnish an evaporating surface of water on the roof, gave the best summer cooling achieved in the experiments. The spray, which was supplied through nozzle-fitted pipes laid lengthwise along the roof, reduced interior temperatures noticeably. The engineers believe that a spray arrangement that supplied only the quantity of water that would be evaporated could give farm families considerably comfort with little waste of water.

T. B. 822 is available for 25 cents a copy from the Superintendent of Documents, Washington 25, D.C.

NEW BOOKS

Milk and Milk Products, by Eckles, Combs, and Macy. Fourth edition. Cloth, xiii+454 pages, 6 x 9 inches. Illustrated and indexed. McGraw-Hill Book Co. (New York 18, N. Y.) $5.00.

This work is primarily a text for a college first course in dairying. It has been brought up to date to present new information on milk, milk products, and related equipment and operations developed since publication of the preceding edition in 1943. Elementary knowledge of chemistry is assumed and is a prerequisite to most effective use of the text. In contrast, the authors have assumed that the users may have no advance knowledge of bacteriology, and have presented that phase of the subject from its elementary fundamentals. Milk handling and processing equipment is treated more or less incidentally from the viewpoint of the user, rather than as an engineering study. Chapters cover the constituents of milk, factors influencing the composition of milk, properties of milk, milk and dairy products as food, microorganisms, the Babcock method for determining fat in milk and cream, common dairy processes, market milk, the manufacture of dairy products — butter, cheese, ice cream, condensed milk, dry milk, milk by-products, dairy arithmetic, and miscellaneous tests.

PROFESSIONAL DIRECTORY

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Allen, Paul B.—Brooksville, Miss.

Barrett, James D.—P.O. Box 235, Clintwood, Va.

Basham, Luther C.—President and gen. mgr., West Virginia Tractor & Equipment Co., P.O. Box 473, Charleston 22, W. Va.

Berk, Martin A.—Draftsman, John Deere Spreader Works. (Mail) 1309 19th Ave., Moline, Ill.

Bigueur, J. M.—Asst. chief, agr. eng. dept., Centro Nacional de Agronomia, Santa Tecla, El Salvador, C. A. (Mail) 3a Calle Oriente No. 1.

Browne, Marion H.—Maintenance engr., Monsanto Chemical Co., Texas City, Tex. (Mail) P.O. Box 626.

Button, L.S., Jr.—Jeffersonton, Va.

Critchfield, John H.—Agr. engr. (SCS), USDA. (Mail) General Delivery, Cheyenne, Okla.

Crouse, Earl A.—Mgr. and operator, Cherry Lane Farms, R.R. 4, Gettysburg, Pa.

Dunham, James A.—2415 Laburnum Ave., Roanoke, Va.

Erickson, Vedick A.—Asst. chief product engr., Richmond Works, International Harvester Co., 520 N. 15th St., Richmond, Ind.

Fulmer, John R., Jr.—Gen. mgr., Clearfield Electric Cooperative, 1120-1122 S. Second St., Clearfield, Pa.

Giles, Burke—P.O. Box 41, Morgan, Utah.

Haas, Clarence C.—Chief product engr., Richmond Works, International Harvester Co., 520 N. 15th St., Richmond, Ind.

Haldeman, George W.—Sales engr., French & Hecht Div., Kelsey-Hayes Wheel Co., Davenport, Iowa.

Harris, Marlin J., Jr.—P.O. Box 416, Auburn, Ala.

Hunck, B. Gene—R.R. 2, Dover, Okla.

Hunt, Donnell R.—Instructor in agr. eng., Iowa State College, Ames, Iowa.

Johnstone, Robert M.—P.O. Box 3532, Virginia Polytechnic Institute Station, Blacksburg, Va.

Kraemer, William T.—Sales engr., Caldwell Plant, Link-Belt Co., Chicago, Ill. (Mail) 8105 S. Hermitage Ave.

Leggett, Armistead M.—719 W. 27th St., Norfolk, Va.

Martin, Frank M.—Product designer, McCormick Wks., International Harvester Co. (Mail) R.R. 1, Route 53, Downers Grove, Ill.

McCanse, James E.—Ed McCanse Ranch, P.O. Box 211, North Powder, Ore.

Moore, William M.—Cardiographic compilation aid, U.S. Naval Hydographic Service. (Mail) R.R. 1, Harrolsburg, Ky.

Morris, Richard P. W.—Design engr. in charge, tractor design dept., Rainham Wks., Ford Motor Co., Ltd. (Mail) 33 Crystal Ave., Hornchurch, Essex, England.

Moysey, Eric B.—Special lecturer in agr. eng., University of Saskatchewan, Saskatoon, Sask., Canada.

Nash, C. A.—Governmental sales mgr., Rish Equipment Co. (Mail) 1402 Boulevard Ave., Huntington, W. Va.

Perry, C. A.—Agr. sales engr., The Ohio Power Co., 111 N. Washington St., Van Wert, Ohio.

Riblet, Donald B.—P.O. Box 5474, Virginia Polytechnic Institute Station, Blacksburg, Va.

Shanks, Clenton W.—P.O. Box 5667, Virginia Polytechnic Institute Station, Blacksburg, Va.

Shirley, Thomas C.—Electrical dev. rep., Electrical Dev. Branch, Tennessee Valley Authority. (Mail) 1110 James Bldg., Chattanooga, Tenn.

Sitterding, Merlin H.—Sales prom. for district agent, Martin Steel Products Corp. (Mail) 120 N. Salisbury St., W. Lafayette, Ind.

Smith, Albert B.—P.O. Box 71, Providence, Utah.

Stevenson, Jack T.—7480 Halpin Ave., St. Louis 21, Mo.

Switzer, Robert W.—Rural service rep., West Penn Power Co., Brownsville, Pa.

Taylor, Warren E.—R.R. 2, Dexter, Kans.

Theimer, Otto F.—Chief engr., Suka-Silo-Bau Heinrich Kling, Muenchen-Solln, Munich, Germany. (Mail) 37 Wilbrechtstrasse.

Urben, Leon J.—Trainee, J. I. Case Co. (Mail) New Glarus, Wis.

Weber, James E.—Sales engr., Virginian Electric, Inc. (Mail) 300 Central Ave., South Charlestown, W. Va.

Winder, John D.—Trainee, Carnation Co. (Mail) P.O. Box 397, College Station, Tex.

Worrell, Robert L.—Product engr., Allis-Chalmers Mfg. Co., La Porte, Ind.

TRANSFER OF MEMBERSHIP GRADE

Tetley, F. A., Jr.—Gen. Mgr., Tetley Nurseries, 844 W. Sixth St., Corona, Calif.

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In the last ten years production methods on the farm have been tremendously speeded by the use of modern machinery. Many crops are now harvested in days instead of weeks. This stepped-up productivity has emphasized the need for farm service buildings that are more functional—buildings which are efficient *production tools*—which supplement machinery in increasing the production of both crops and animals.

With a Stran-Steel Quonset, the farmer has the finest non-combustible farm service building obtainable. It provides maximum comfort, convenience, efficiency, durability and adaptability. Its clean functional lines make it a source of pride and satisfaction. Its low maintenance cost and dependability mark it as a sound investment that will keep on producing year after year.

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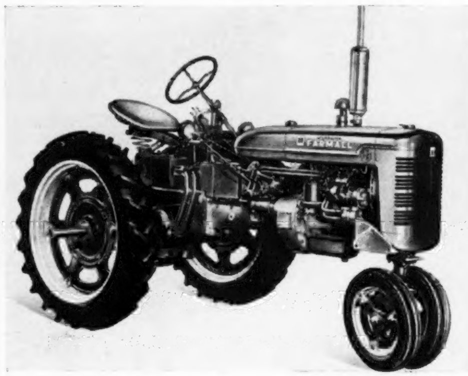
NEWS FROM ADVERTISERS

New Products and Literature Announced by AGRICULTURAL ENGINEERING Advertisers

New Farmall Super C Tractor. A new McCormick Farmall tractor — the two-row, two-plow Super C — has been announced by International Harvester Co. It has 17 major improvements. In the engine, bigger cylinder bore gets 12 per cent more power. Battery ignition, with automatic spark advance, provides smoother power and increased lugging ability over the entire load range. A bigger-capacity, pressurized cooling system maintains proper engine temperature in all weather. Heavy-duty connecting-rod bearings, of a type similar to those in big diesels, are used. New self-energizing disk brakes, which operate at a toe-touch, make pin-point turns easier, high-speed stops safer, and are easily adjusted. The Farmall Touch-Control system, which raises, lowers, and regulates mounted equipment hydraulically, has been improved for greater durability. A softer-riding, upholstered, hydraulic seat and more easily reached clutch and brake pedals contribute to operator comfort. The chassis has been strengthened from front to rear. Heavy web ribbing reinforces the transmission-differential case. Like the other Farmall tractors — the Cub, Super A, H, and M — the new Super C has a full line of matched McCormick equipment.



New McCormick Farmall Super C tractor

Massey-Harris Pull-Type Combine. The new combine will incorporate many important features to do a better and faster job of harvesting a difficult crop. The Massey-Harris machine is a large-capacity, straight-through, cylinder-type combine with a pick-up attachment for combining from the windrow. It is equipped with sealed ball bearings throughout, spiked-tooth cylinder and concave. The bottom of the elevators, the auger tubes and the bottom of the table are perforated to let sand and dust escape. The combine is available as a power-take-off model or with an auxiliary engine. The new pull-type combine will do the work of 12 men formerly required in the harvesting of peanuts. It is a practical, cost-reducing unit both for the farmer who harvests his own crops, and for the custom operator who contracts for large acreages. In view of the labor situation, the new combine should be an important factor in raising the production of this vital crop.

Massey-Harris peanut combine

Personnel Service Bulletin

The American Society of Agricultural Engineers conducts a Personnel Service at its headquarters office in St. Joseph, Michigan, as a clearing house (not a placement bureau) for putting agricultural engineers seeking employment or change of employment in touch with possible employers of their services, and vice versa. The service is rendered without charge, and information on how to use it will be furnished by the Society. The Society does not investigate or guarantee the representations made by parties listed. This bulletin contains the active listing of "Positions Open" and "Positions Wanted" on file at the Society's office, and information on each in the form of separate mimeographed sheets, may be had on request. "Agricultural Engineer" as used in these listings, is not intended to imply any specific level of proficiency, or registration, or license as a professional engineer.

NOTE: In this bulletin the following listings still current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated:

POSITIONS OPEN: NOVEMBER—O-102-510. DECEMBER—O-113-514. 1951—FEBRUARY—O-168-517. APRIL—O-177-523, 226-525.

POSITIONS WANTED: SEPTEMBER—W-40-10. OCTOBER—W-69-13, 73-14, 71-15. NOVEMBER—W-99-18. 1951—JANUARY—W-140-25, 145-27. FEBRUARY—W-156-31, 162-33, 164-35. MARCH—W-116-36, 120-37, 172-39, 184-40, 176-41, 185-42, 188-43. APRIL—W-196-44, 202-46, 227-47, 212-48, 222-49, 229-50, 219-51. MAY—W-240-52, 252-53, 253-54, 237-55, 276-56, 277-57.

NEW POSITION OPEN

SHOP FOREMAN to establish and operate a new, well-equipped shop, and to assist with shop instruction and research. Location, Bangkok, Thailand. Position requires understanding of elementary engineering principles. College graduation desirable but not essential. Calls for good mechanic with ability to maintain a neat and efficient shop, and to work happily in a foreign tropical environment. Experience in automotive repair, welding, woodwork, and simple machine tool work desirable. Two-year contract. Salary not specified but comparable with that for similar position in the U.S.A., plus 25 per cent differential, quarters allowance, and round-trip transportation. O-293-526

NEW POSITIONS WANTED

DESIGN, development, research, sales, or service in farm structures or soil and water field, in public service or industry, preferably in Wisconsin or West of the Mississippi River. BS deg in agriculture, 1948, University of Wisconsin. Senior standing for BS deg in civil engineering. Graduate study on underground water, 1950, and on hydraulic structures and machinery, 1951. Farm background. Undergraduate assistant in agronomy, 2 yr. Land leveling and irrigation work in West with S.C.S., 7 mo. Drainage, farm pond, and erosion control structures work in Ohio with S.C.S., 2 yr. War enlisted service in Army Air Force, 16 mo. Married. Age 25. No disability. Available on 30 days' notice. Salary open. W-264-58

SALES or service in power and machinery field in industry with manufacturer or distributor, preferably within northern half of the U.S.A. BS deg in agriculture, major in commercial agricultural engineering, expected in June, University of Wisconsin. Farm work six summers, including operation of modern farm machinery. Office work in State 4-H Club office, Madison. Member Naval Reserve. Single. Age 22. No disability. Available June 18. Salary $275 mo. W-260-59

DESIGN, development, or research in power and machinery or product processing with experiment station or industry anywhere in U.S.A. BS deg in agricultural engineering, Iowa State College, 1939. MS deg in agricultural engineering, Louisiana State University, 1944. Professional degree in agricultural engineering, Iowa State College, 1948. Farm background, including 2 yr full-time farming before college. Junior engineer U.S.D.A., 3 yr. Research associate and assistant agricultural engineer, specializing in rice drying, Louisiana Agricultural Experiment Station, 3½ yr. Commercial experience with rice drier co-op, 6 mo. Associate agricultural engineer and agricultural engineer, U.S.D.A., 4½ yr in research on sugar cane and rice production and handling problems. Licensed professional engineer in Texas. Married. Age 36. No disability. Available July 1. Salary open. W-232-60

DESIGN, development, research or writing in soil and water field, with industry, preferably in Southeast. BS deg in agricultural engineering, 1950, Iowa State College. Part time truck, dairy, and grain farm work 7 yr. Part time work while in college in office and in welding and metal construction. Employed since graduation as winch operator and trailer driver. Married. Age 22. No disability. Available now. Salary open. W-251-61

DESIGN, development, or research in power and machinery with college or experiment station in a western state. BS deg in agricultural engineering, 1951, Utah State Agricultural College. Farm background on irrigated farm in Idaho. Nearly two years as mechanic on maintenance, overhaul, repair, service and assembly of tractors and farm machinery. Several months as carpenter on assembly and construction of prefabricated houses. War service in Army Air Force 5 yr. Married. Age 33. No disability. Available June 15. Salary open. W-261-62.

DESIGN, development, or research in the power and machinery field, in public service. BS deg in agricultural engineering, 1951, Louisiana State University. Student assistant in Louisiana Agricultural Experiment Station, 2 yr. Single. Age 22. No disability. Available now. Salary $300 mo. W-280-63

RESEARCH, design, development, extension, or teaching in farm structures, with public service or industry, anywhere in U.S.A. except deep South. Other, Alaska. Willing to travel. BS deg, 1948, MS deg expected June 18, both in agricultural engineering, Michigan State College. Farm background. Graduate research 2½ yr with Michigan Agricultural Experiment Station and U.S.D.A. War enlisted service in Army, 3¼ yr. Married. Age 29. No disability. Available June 18. Salary open. W-262-64

DESIGN, development, or research in power and machinery with manufacturer, preferably in Midwest. Willing to travel or spend 2 yr in foreign service. BS deg in agricultural engineering 1951, University of Missouri. Farm background. Experience with most types of farm machinery and some with large construction machinery. War enlisted service in Army, 2½ yr. Single. Age 24. No disability. Available June 15. Salary $3600. W-263-65